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INDEX OF CONSERVATION DIVISION GUIDELINES

Item No.	Definitions, Laws, Regulations, Memoranda and other Guidelines with examples

VOL I

1	Establishment of the Geological Survey Creation, Objectives and Function of Conservation Division Area Geologist's Office
2	Mineral Leasing Act of 1920
3	Public Law 585 - Multiple Mineral Resource Development
4	Secretary's Order 2948 - BLM-USGS Onshore Minerals Management
5	Mineral Land Classification - Authority, Purpose, History
6	Mineral Resource Classification System - Current Status Formal and Informal Classification Actions
7	Legal Descriptions of Tracts of Land
8	Known Leasing Areas - Existence and workability
9	Mineral Permits and Leases
10	Geothermal - classification, working agreements
11	Coal - classification and evaluation standards
12	Oil and Gas - classification and evaluation standards
13	Oil Shale - classification standards - withdrawal
14	Phosphate - calssification and evaluation standards
15	Sodium and Potash - classification and evaluation standards

VOL II

16	Geologic Reports
17	Prospecting Permits
18	Preference Right and Competitive Lease applications
19	Congressional and Public Inquiries
20	Fringe Acreage Application
21	Exploration and Mining Plan Reviews
22	Prospectively Valuable Reports
23	Input to Environmental Analysees and EIS
24	Dam and pump storage sites
25	Land classification minutes
26	Known Leasing Area (KLA) minutes
27	Environmental Analysis - procedures for Onshore Mining and resource evaluation
28	Technical Publications and Open-file reports
29	Projects - proposals and examples
30	Analytical lab sample submittal procedure
31	Conservation Division Glossary

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Department of Interior record provisions and Government records and papers, see section 1460 et seq. of this title, and section 1733 of Title 28, Judiciary and Judicial Procedure.

§ 22. Repealed. July 30, 1947, ch. 354, § 2, 61 Stat. 522.

Section, act June 5, 1920, ch. 235, § 1, 41 Stat. 908, which related to cost of photolithographic copies of plats, is now covered by section 1460 of this title.

§ 23. Repealed. Pub. L. 86–649, title II, § 202(b), July 14, 1960, 74 Stat. 507.

Section, act Feb. 14, 1931, ch. 187, 46 Stat. 1118, which prescribed the fees for depositions in hearings in the Bureau of Land Management, is now covered by section 1371 of this title.

SIMILAR PROVISIONS

Similar provisions were contained in the following prior Appropriation Acts:

1925—Mar. 3, 1925, ch. 462, 43 Stat. 1145.
1924—June 5, 1924, ch. 264, 43 Stat. 395.
1923—Jan. 24, 1923, ch. 42, 42 Stat. 1179.
1922—May 24, 1922, ch. 199, 42 Stat. 558.
1915—Mar. 3, 1915, ch. 75, § 1, 38 Stat. 855.

§ 24. Repealed. Pub. L. 89–554, § 8(a), Sept. 6, 1966, 80 Stat. 646, 647.

Section, acts May 10, 1926, ch. 277, § 1, 44 Stat. 456; Jan. 12, 1927, ch. 27, § 1, 44 Stat. 938, authorized payment of mileage for automobile travel.

§§ 25 to 25b. Repealed. Oct. 25, 1951, ch. 562, § 1 (25), 65 Stat. 639.

Sections, act May 28, 1926, ch. 415, §§ 1—3, 44 Stat. 672, 673, which related to transfer to each State, upon the closing of the last land office therein, of land office records, field notes, maps, etc., is now covered by section 3301 et seq. of Title 44, Public Printing and Documents.

Chapter 2—GEOLOGICAL SURVEY

Sec.
31. Director of Geological Survey.
  (a) Establishment of office; appointment and duties; examination of geological structure, mineral resources, and products of the national domain; prohibitions in respect to lands and surveys.
  (b) Examination of geological structure, mineral resources, and products outside the national domain.
  (c) Report to Congress.
32. Acting Director.
33. Repealed.
34. Scientific employees.
35. Repealed.
36. Purchase of books.
36a. Acquisition of scientific or technical books, maps, etc., for library.
36b. Acquisition of lands or interests therein for use in gaging streams or underground water resources.
37. Purchases or services for Geological Survey.
38. Topographic surveys; marking elevations.
39, 40. Omitted.
41. Publications and reports; preparation and sale.
42. Distribution of maps and atlases, etc.
43. Copies to Senators, Representatives, and Delegates.
44. Sale of transfers or copies of data.
45. Production and sale of copies of photographs and records; disposition of receipts.
46. Exchange of old freight-carrying vehicles as part payment for new.
47. Repealed.
48. Disposition of amounts received from State, Territory, etc.
49. Extension of cooperative work to Puerto Rico.
50. Survey's share of cost of topographic mapping or water resources investigations carried on with States.

§ 31. Director of Geological Survey.

(a) Establishment of office; appointment and duties; examination of geological structure, mineral resources, and products of the national domain; prohibitions in respect to lands and surveys.

The Director of the Geological Survey, which office is established, under the Interior Department, shall be appointed by the President by and with the advice and consent of the Senate. This officer shall have the direction of the Geological Survey, and the classification of the public lands and examination of the geological structure, mineral resources, and products of the national domain. The Director and members of the Geological Survey shall have no personal or private interests in the lands or mineral wealth of the region under survey, and shall execute no surveys or examinations for private parties or corporations.

(b) Examination of geological structure, mineral resources, and products outside the national domain.

The authority of the Secretary of the Interior, exercised through the Geological Survey of the Department of the Interior, to examine the geological structure, mineral resources, and products of the national domain, is expanded to authorize such examinations outside the national domain where determined by the Secretary to be in the national interest.

(c) Report to Congress.

The Secretary of the Interior shall report to the Speaker of the House of Representatives and the President of the Senate on January 31 and July 31 of each year on all actions taken pursuant to subsection (b) of this section during the six months ending on the December 31 and June 30 immediately preceding the reporting date and on the results of such actions. (Mar. 3, 1879, ch. 182, § 1, 20 Stat. 394; Sept. 5, 1962, Pub. L. 87–626, §§ 1, 2, 76 Stat. 427.)

CODIFICATION

Subsec. (a) is from Act Mar. 3, 1879. Subsecs. (b) and (c) are sections 1 and 2, respectively, of Pub. L. 87–626.

Provisions of subsec. (a) which limited the salary of the Director of the Geological Survey to $8,000 a year were omitted as obsolete. See chapter 51 and subchapter III of chapter 53 of Title 5, Government Organization and Employees.

TRANSFER OF FUNCTIONS

All functions of all other officers of the Department of the Interior and all functions of all agencies and employees of that Department were, with two exceptions, transferred to the Secretary of the Interior, with power vested in him to authorize their performance or the performance of any of his functions by any of those officers, agencies, and employees, by 1950 Reorg. Plan No. 3, §§ 1, 2, eff. May 24, 1950, 15 F. R. 3174, 64 Stat. 1262, set out in the Appendix to Title 5.

§ 32. Acting Director.

The Secretary of the Interior may authorize one of the geologists to act as Director of the Geological Survey in the absence of that officer. (July 31, 1894, ch. 174, § 1, 28 Stat. 197.)

TRANSFER OF FUNCTIONS

All functions of all other officers of the Department of the Interior and all functions of all agencies and employees of that Department were, with two exceptions, transferred to the Secretary of the Interior, with power vested in him to authorize their performance or the

performance of any of his functions by any of those officers, agencies, and employees, by 1950 Reorg. Plan No. 3, §§ 1, 2, eff. May 24, 1950, 15 F. R. 3174, 64 Stat. 1262, set out in the Appendix to Title 5, Government Organization and Employees.

§ 33. Repealed. Aug. 10, 1956, ch. 1041, § 53, 70A Stat. 641.

Section, act June 16, 1880, ch. 235, 21 Stat. 274, authorized the Secretary of War to detail officers of the Ordnance Corps to serve with the Geological Survey.

§ 34. Scientific employees.

The scientific employees of the Geological Survey shall be selected by the director, subject to the approval of the Secretary of the Interior exclusively for their qualifications as professional experts. (July 7, 1884, ch. 332, 23 Stat. 212.)

TRANSFER OF FUNCTIONS

All functions of all other officers of the Department of the Interior and all functions of all agencies and employees of that Department were, with two exceptions, transferred to the Secretary of the Interior, with power vested in him to authorize their performance or the performance of any of his functions by any of those officers, agencies, and employees, by 1950 Reorg. Plan No. 3, §§ 1, 2, eff. May 24, 1950, 15 F. R. 3174, 64 Stat. 1262, set out in the Appendix to Title 5, Government Organization and Employees.

§ 35. Repealed. Pub. L. 87–304, § 9(a)(2), Sept. 26, 1961, 75 Stat. 664.

Section, act June 30, 1906, ch. 3914, § 1, 34 Stat. 727, authorized scientific and other employees of the United States Geological Survey employed in the field to make assignments of pay, and that they be reimbursed for expenses incurred in the discharge of duty in the field and paid from personal funds. See section 5525 of Title 5, Government Organization and Employees.

§ 36. Purchase of books.

The purchase of professional and scientific books and periodicals needed for statistical purposes by the scientific divisions of the United States Geological Survey is authorized to be made and paid for out of appropriations made for the said Survey. (June 28, 1902, ch. 1301, § 1, 32 Stat. 455.)

TRANSFER OF FUNCTIONS

All functions of all other officers of the Department of the Interior and all functions of all agencies and employees of that Department were, with two exceptions, transferred to the Secretary of the Interior, with power vested in him to authorize their performance or the performance of any of his functions by any of those officers, agencies, and employees, by 1950 Reorg. Plan No. 3, §§ 1, 2, eff. May 24, 1950, 15 F. R. 3174, 64 Stat. 1262, set out in the Appendix to Title 5, Government Organization and Employees.

§ 36a. Acquisition of scientific or technical books, maps, etc., for library.

The Director of the Geological Survey, under the general supervision of the Secretary of the Interior, is authorized to acquire for the United States, by gift or devise, scientific or technical books, manuscripts, maps, and related materials, and to deposit the same in the library of the Geological Survey for reference and use as authorized by law. (May 14, 1940, ch. 190, 54 Stat. 212.)

TRANSFER OF FUNCTIONS

All functions of all other officers of the Department of the Interior and all functions of all agencies and employees of that Department were, with two exceptions, transferred to the Secretary of the Interior, with power vested in him to authorize their performance or the performance of any of his functions by any of those officers, agencies, and employees, by 1950 Reorg. Plan No. 3, §§ 1, 2, eff. May 24, 1950, 15 F. R. 3174, 64 Stat. 1262, set out in the Appendix to Title 5, Government Organization and Employees.

§ 36b. Acquisition of lands or interests therein for use in gaging streams or underground water resources.

The Secretary of the Interior may, on behalf of the United States and for use by the Geological Survey in gaging streams and underground water resources, acquire lands by donation or when funds have been appropriated by Congress by purchase or condemnation, but not in excess of ten acres for any one stream gaging station or observation well site. For the same purpose the Secretary of the Interior may obtain easements, licenses, rights-of-way, and leases limited to run for such a period of time or term of years as may be required for the effective performance of the function of gaging streams and underground water resources: *Provided*, That nothing in this section shall be construed as affecting or intended to affect or in any way to interfere with the laws of any State or Territory relating to the control, appropriation, use, or distribution of water used in irrigation, or any vested right acquired thereunder, and the Secretary of the Interior, in carrying out the provisions of this section, shall proceed in conformity with such laws, and nothing in this section shall in any way affect any right of any State or of the Federal Government or of any landowner, appropriator, or user of water, in, to, or from any interstate stream or the waters thereof. (Dec. 24, 1942, ch. 822, 56 Stat. 1086; Apr. 4, 1960, Pub. L. 86–406, 74 Stat. 14.)

AMENDMENTS

1960—Pub. L. 86–406 authorized the Secretary of the Interior to acquire lands and interests in lands for observation well sites to gage underground water resources.

TRANSFER OF FUNCTIONS

All functions of all other officers of the Department of the Interior and all functions of all agencies and employees of that Department were, with two exceptions, transferred to the Secretary of the Interior, with power vested in him to authorize their performance or the performance of any of his functions by any of those officers, agencies, and employees, by 1950 Reorg. Plan No. 3, §§ 1, 2, eff. May 24, 1950, 15 F. R. 3174, 64 Stat. 1262, set out in the Appendix to Title 5, Government Organization and Employees.

§ 37. Purchases or services for Geological Survey.

CODIFICATION

Section, act June 12, 1917, ch. 27, § 1, 40 Stat. 144, is now covered by section 751 et seq. and section 471 et seq. of Title 40, Public Buildings, Property, and Works, chapter 4 of Title 41, Public Contracts, and chapters 21, 25, 27, 29, and 31 of Title 44, Public Printing and Documents.

§ 38. Topographic surveys; marking elevations.

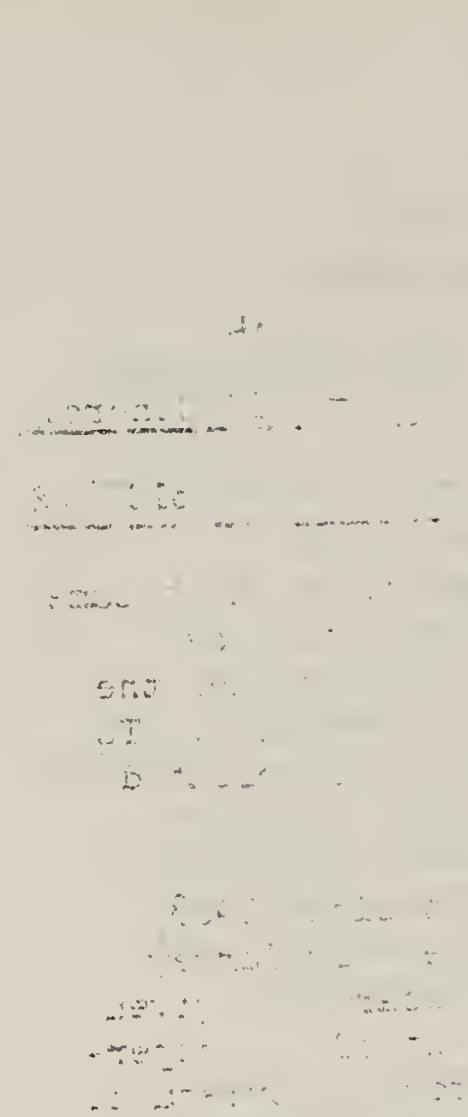
In making topographic surveys west of the ninety-fifth meridian elevations above a base level located in each area under survey shall be determined and marked on the ground by iron or stone posts or permanent bench marks, at least two such posts or bench marks to be established in each township, or equivalent area, except in the forest-clad and mountain areas, where at least one shall be established, and these shall be placed, whenever practicable,

.1 Creation. The Geological Survey was established by the Act of March 3, 1879 (20 Stat. 394; 43 U.S.C. 31), which imposed upon the Director two distinct types of duty: (1) the classification of the public land, and (2) the examination of the geologic structure and mineral resources. The responsibility for mineral land classification as it is now applied is assigned to the Branch of Mineral Classification which is an organizational unit of the Conservation Division of the Geological Survey. Its organizational form and functional operations have developed through legislation and executive, departmental, and bureau orders in recognition of the needs of scientific mineral land classification as an integral part of public land administration.

The Director, Geological Survey, in the first annual report to the Secretary of the Interior, dated November 1, 1880, stated that it was his conclusion that the intent of Congress in the enactment of the legislation creating the Geological Survey was "..... to begin a rigid scientific classification of the lands of the national domain, not for purposes of aiding the machinery of the General Land Office by furnishing a basis for sale, but for the general information of the country...." This interpretation of the intent of Congress as expressed in the Organic Act prevailed until 1906, when it became evident that adequate classification of mineral lands was essential to effective public land administration. Legislation of that era made it plain that it was the intent of Congress that public lands be classified and that disposal of lands be in accordance with such classification of the lands into types recognized in the statutes.

On June 29, 1906, the President directed the Interior Department to report valuable coal lands, so that they could be withheld from entry under the Public Land and Mining Laws. The Geological Survey, from data accumulated in its records, prepared maps showing the location of coal lands in the western public land states. As directed, the General Land Office withdrew from entry the lands designated by the Survey as valuable for coal (USGS Bull. 537, 1913, "Classification of the Public Lands").

A series of orders from the Secretary of the Interior defined the roles that the General Land Office and the Geological Survey would bear in public land administration with the Survey being made chiefly responsible for the classification of lands for their mineral character. From these actions the Survey's responsibilities became clear, and as demands upon



the Survey for information became more frequent and numerous it became necessary to create within the Survey a unit responsible for the assemblage of information obtained from field investigations and the conversion of such data into a form suitable for classification. To provide for this activity the Land Classification Board was created by order of the Director on December 18, 1908.

Historically, classification has remained in this unit since 1908, although various organizational changes have been made. By Survey Order No. 10 of May 1, 1912, the Land Classification Board was given the rank of branch (now division). With the assignment of the supervisory responsibilities of the Mineral Leasing Act from the Bureau of Mines, the Conservation Branch was created by Survey Order No. 115, dated July 1, 1925, which provided that:

> "The Conservation Branch (now Division) will continue the functions of the former Land Classification Board, together with the mineral leasing activities transferred today from the Bureau of Mines."

From this chain of events emerged the Mineral Classification Branch as the unit charged with the duties of mineral land classification. Except for expanded responsibilities in its participation in the administration of the Mineral Leasing Act and a broadening of cooperation in an advisory capacity for intradivision, intrabureau, and interagency activities dealing with mineral resources of lands under the jurisdiction of these government units and a redesignation of title, the Branch of Mineral Classification has functioned along similar lines since its creation in 1908 as the Land Classification Board. (See USGS Bull. 537, 1913, "Classification of the Public Lands".)

.2 Objectives. The role of the Branch of Mineral Classification in its prime objective is (1) to conduct a scientific classification of the lands under Federal jurisdiction to determine the actual or probable presence of leasable and other mineral deposits of value on such lands anywhere in the United States or its territories; (2) to prepare geologic maps and reports and assemble the data required in the mineral classification of Federal lands; (3) make certain technical determinations of a geologic nature required in the administration of the Mineral Leasing Act of 1920 (as amended); (4) to furnish other Federal administrative and supervising agencies with geologic determinations and counsel

requisite to the management of the lands under their jurisdiction; (5) to maintain a file of the data accumulated by field investigations in a manner that the collected geologic data may be readily translated into a classification of the mineral resources of Federal lands, and to prepare for open file or publication the results of these investigations.

.3 Functions. To fulfill these objectives the Branch maintains a staff of geologists strategically located to conduct the field investigations necessary to provide a basis for classification.

From field and laboratory data and other sources including suitable work by the Survey or other agencies, the Branch (1) determines the land areas of potential value for the leasable minerals that are to be withdrawn for purposes of mineral investigation and classification; (2) classifies the lands as being mineral or nonmineral in character; (3) initiates order for the formal classification of those lands mineral in character, and recommends the restoration of those lands after classification; (4) assemble the acquired data into a systematic record upon which daily determinations may be made as to the mineral character of Public, Acquired, and Indian lands subject to disposal under appropriate statutes; (5) under the provisions of the Mineral Leasing Act defines the areas to be included in "Known Geologic Structures" of producing oil and gas fields; under the provision of the Act of August 8, 1946, determines the producing limits of oil or gas fields and the determination of "discovery of new deposits"; reports to the Bureau of Land Management on the first discovery of oil or gas and other leasable minerals on or affecting Federal lands; (6) reports on all oil or gas lease offers as to whether or not such lands are subject to noncompetitive or competitive leasing; (7) recommends the logical area of proposed unit plans and participating areas; (8) provides advisory services to other Branches of the Division and performs geologic investigations that may be required in determining the feasibility of potential dam or reservoir sites and the administration of the Mineral Leasing Acts, including the Outer Continental Shelf Lands Act; and (9) provides geologic counsel to bureaus of the Department and to other governmental agencies on problems relating to administration of lands under their jurisdiction, particularly and most frequently in determining the mineral resources of lands subject to disposal.

To systematically map and evaluate the large areas in need of mineral land classification a program of general geologic mapping is under way in the western states and Florida.

.1 General Functions. The Conservation Division examines and classifies Federal lands in the United States as to their mineral character and waterpower and water-storage values; supervises technical operations under oil and gas and other mineral leases on Federal, Outer Continental Shelf, Indian, and Naval petroleum reserve lands, and maintains accounts of related production and royalty accruals. The Division maintains for the Secretary of the Interior and the Bureaus under his direction a consulting service on the geological, minerals inventory and evaluation, and mineral-production engineering aspects of public land administration.

.2 Headquarters Organization. The Division headquarters office in Washington, D.C. consists of the Office of the Division Chief, including his immediate staff, an Assistant Division Chief for Operations, an Assistant Division Chief for Resources Evaluation, and an Assistant Division Chief for Programs.

A. The Office of the Division Chief consists of the Chief of the Division, the Associate Division Chief, Staff Assistants, and the Administrative Officer. These officials exercise the authority delegated by the Director for the execution of all programs and performance of delegated duties.

B. The Assistant Division Chief for Operations assists the Division Chief's office in the development of programs relating to the regulation and supervision of operations on oil and gas leases and mining permits and leases on Federal, Indian, and Outer Continental Shelf (OCS) lands; develops accounting standards, procedures, and instructions and maintains royalty control accounts; develops technical operating standards and procedures; and provides technical guidance in the execution of the Division's responsibilities in these areas of activity. The staff offices required to carry out these functions are:

(1) The Branch of Onshore Oil and Gas Operations provides headquarters staff leadership in the development of standards, criteria and regulations for Federal supervision of industry operations on Federal and Indian oil and gas and geothermal leases; provides policy level guidance to the Chief, Conservation Division and technical guidance to Regional Conservation Managers on matters pertaining to the development of Federal and Indian oil and gas and geothermal resources; and maintains a system of controls to assure program balance between Regions and the highest performance in all areas of responsibility in the onshore oil and gas lease management program.

(2) The Branch of Marine Oil and Gas Operations provides headquarters staff leadership in the development of standards, criteria and regulations for Federal supervision of industry operations on OCS oil and gas and sulfur leases; provides policy level guidance to the Chief, Conservation Division and technical guidance to Regional Conservation Managers and the Gulf of Mexico Manager on matters pertaining to the development of OCS oil and gas resources; and maintains a system of controls to assure highest performance in all areas of responsibility in the OCS oil and gas lease management program.

(3) The Branch of Mining Operations provides headquarters staff leadership in the development of standards, criteria, and regulations for Federal supervision of industry operations on Federal and Indian mining leases and permits; provides policy level guidance to the Chief, Conservation Division, and technical guidance to the Regional Conservation Managers on matters pertaining to the development of leasable Federal and Indian mineral resources (other than oil, gas, and geothermal); maintains a system of controls to assure program balance between the Regions and the highest performance of all areas of responsibility in the mining lease and permit management program.

C. The Assistant Division Chief for Resource Evaluation assists the Division Chief's office in the development of national programs for the mapping, classification, evaluation, and inventory of the leasable mineral resources of public, acquired, and Outer Continental Shelf lands, and reservoir and waterpower sites on public lands; provides technical guidance to the Regional Conservation Managers on matters pertaining to the classification and evaluation of leasable mineral and water development potential of the Federal lands and the assessment of fair market value of mineral resources offered for lease by competitive bidding. The staff offices required to carry out these functions are:

(1) The Branch of Onshore Evaluation provides headquarters staff leadership to the conduct of leasable mineral resource evaluation programs on Federal lands onshore; provides policy level guidance to the Chief, Conservation Division and technical guidance to the Regional Conservation Managers on matters pertaining to resource evaluation and inventory of oil and gas, geothermal resources, coal, oil shale, and other leasable minerals on public and acquired lands; maintains a system of controls to assure program balance between the Regions and the highest performance in all areas of responsibility in the onshore resource evaluation program.

(2) The Branch of Marine Evaluation provides headquarters staff leadership to the conduct of marine mineral resource evaluation programs on Federal lands offshore; provides policy level guidance to the Chief, Conservation Division, and technical guidance to the Regional Conservation Managers and the Gulf of Mexico Manager on matters pertaining to resource evaluation and inventory of oil and gas and other minerals on Outer Continental Shelf lands; maintains a system of controls to assure program balance between the Regions and the highest performance in all areas of responsibility in the marine resource evaluation program.

(3) The Branch of Mineral and Water Classification provides headquarters staff leadership to the conduct of mineral and water classification programs on Federal lands; provides policy level guidance to the Chief, Conservation Division and technical guidance to the Regional Conservation Managers on matters pertaining to mapping and classification of potentially valuable and valuable mineral lands and waterpower and reservoir sites on public and acquired lands; maintains a system of controls to assure program balance between the Regions and the highest performance in all areas of responsibility in the resource classification program.

D. The Assistant Division Chief for Programs assists the Division Chief's office in program planning and analysis, budget preparation, systems analysis and development, environmental impact analysis, review and coordination, economic and statistical analysis and reporting, development and coordination of Division employee training programs, generation of briefing and informational materials, and the development of non-technical publications on Division activities at the layman's level for general public distribution.

3 Field Organization. The field organization of the Division consists of three regional offices, each of which is responsible within the designated geographical area for the full range of operational activities delegated to the Division, and an office responsible for Gulf of Mexico Outer Continental Shelf (OCS) operations. Each of these four offices reports directly to the Division Chief.

A. The Gulf of Mexico OCS Operations (headquartered in New Orleans-Metairie, Louisiana) includes all offshore activities in the Gulf of Mexico. It is headed by a Manager who is responsible, at the same level and under the same program direction as the Regional Conservation Managers described below, for operating and coordinating the full Gulf of Mexico program involving:

(1) Supervision of all operations and activities for the exploration, development, and production of oil, gas, sulfur, and other minerals leasable under the OCS Lands Act in accordance with operating and other regulations and orders;

(2) Supervision of the determination from pertinent geological, geophysical and engineering data and evidence of the actual or probable presence of mineral deposits of value in specific tracts or areas, the calculation of reserves, the determination of fair market value of tracts offered for lease, and the analysis of environmental factors influencing development.

B. Each Regional Office is headed by a Conservation Manager who is responsible for operating and coordinating a full program involving:

(1) Supervision of operations and activities for the prospecting, development, and production of oil and gas from leases on Federal, Indian, and certain Naval petroleum reserve lands subject to the various mineral leasing laws, and administers geothermal resources operating regulations;

(2) Supervision of operations and activities for the prospecting, development, and production of various minerals and solid fuels under leases on Federal and Indian lands, subject to the various leasing laws;

(3) Supervision of the determination from pertinent geological data and evidence of the actual or probable presence of mineral deposits of value in specific tracts or parcels of public land; the protection of such mineral estates (by timely notice, withdrawal, or classification) from inadvertent disposal under nonmineral land laws; the promotion of the exploration and development of such estates under applicable provisions of the Federal mining or mineral leasing laws; and the prompt provision to the administrative and supervising agencies involved in such development, of the geologic determinations and counsel requisite to the effective discharge of their responsibilities;

(4) Supervision of the identification and classification of potential power and reservoir sites; the protection of such sites on Federal land by initiation of formal classifications; the forestalling of encumbrances of sites by furnishing data

and recommendations concerning other uses of classified lands; the continuing review and revision of such classifications; and the preparation for publication and for administrative use of maps and reports on the results of investigations;

(5) Serves as the Division representative on the Survey Committee at field centers, is responsible for the Division's activities in liaison with the Survey Assistant Director for the Region, and acts as advisor to Geological Survey representatives on Departmental field committees and on interagency groups.

C. Regional Office Areas.

(1) Western region (headquartered at Menlo Park, California) includes the States of Alaska, Arizona, California, Hawaii, Idaho, Nevada, Oregon, Washington, and the Outer Continental Shelf of the Pacific Ocean.

(2) Central region (headquartered at Denver, Colorado) includes the States of Arkansas, Colorado, Iowa, Kansas, Louisiana, Missouri, Montana, Nebraska, New Mexico, North Dakota, Oklahoma, South Dakota, Texas, Utah, and Wyoming.

(3) Eastern region (headquartered at Washington, D.C.) includes all other States of the United States, Puerto Rico, Virgin Islands, and the Outer Continental Shelf of the Atlantic Ocean.

Department of the Interior

GEOLOGICAL SURVEY
CONSERVATION DIVISION MANUAL

.1 Creation. Department of the Interior Order No. 54, dated June 25, 1925, transferred to the Geological Survey, effective July 1, 1925, the Oil Leasing Division and the Mineral Leasing Division of the Bureau of Mines and authorized the Survey to exercise the powers and authority vested in those Divisions under the Bureau of Mines. The Conservation Branch was created by Survey Order No. 115, dated July 1, 1925, which provided that:

> "The Conservation Branch will continue the functions of the former Land Classification Branch together with the mineral-leasing activities transferred today from the Bureau of Mines."

The "Conservation Branch" became the "Conservation Division" as of January 1, 1949, pursuant to Survey Order No. 173, dated December 15, 1948.

.2 Functions. The functions of the division are concerned principally with the management, conservation and development of natural resources with special emphasis on geothermal resources, oil and gas, and other mineral resources. The principal functions of the Conservation Division are: (1) examine and classify Federal lands as to their mineral character and their value for waterpower and water-storage reservoir sites; (2) manage exploration, development and other technical operations under geothermal resources, oil and gas, and other mineral leases embracing Federal and Indian lands, naval petroleum reserve lands, and submerged lands of the Outer Continental Shelf to assure safe workmanlike operations by Lessees and operators on Federal and Indian lands; (3) maintain accounts of production from Federal and Indian leases for geothermal resources, oil and gas, and other leasable minerals and royalty accrual thereunder; (4) provide consulting services for the Secretary of the Interior and Bureaus under his direction on the management of nationally-owned resources lands; and (5) disseminate data relative to the foregoing activities.

*.3 Objectives. In formulating and administering programs for inventory evaluation, safe and orderly exploration and development, conservation and wise use of nationally-owned resources, the Conservation Division pursues the following objectives:

(1) Expedite accurate identification and classification of public and acquired lands of the United States as to their potential mineral value and/or their value for water power or water storage reservoir sites;

(2) Encourage the efficient use and assure safe orderly exploration for and development of nationally-owned natural resources so that the needs for national security and a healthy economy may be met in a manner which is consistent with the necessary protection and, where practicable, enhancement of the environment.

(3) Discourage wasteful exploitation of nationally-owned resources; and

(4) Promote an equitable distribution of the benefits to be gained from nationally-owned natural resources.*

.1 General Organization. The Conservation Division consists of a headquarters organization located in *Reston, Virginia (Washington, D.C.)* and a field organization composed of *three regional offices, an office responsible for Gulf of Mexico - Outer Continental Shelf Operations, area offices, district offices and district inspection offices.*

.2 Headquarters Organization. The Division headquarters organization in *Reston, Virginia,* consists of the Office of the Division Chief, *the Office of the Assistant Division Chief for Operations, the Office of the Assistant Division Chief for Resource Evaluation, and the Office of the Assistant Division Chief for Programs.*

*A. The Office of the Division Chief consists of the Chief of the Division, the Associate Division Chief, their immediate Staffs, the Legislation, Regulations and Appeals Section, and the Office of the Administrative Officer. The authority delegated by the Director for the execution of programs and the performance of delegated duties is exercised through this office.

(1) The Legislation, Regulations and Appeals Section consists of the Legal Staff Assistant and his immediate staff. The Legislation, Regulations and Appeals Section provides staff assistance to the Division Chief and Associate Division Chief and headquarters staff leadership in the development and review of proposed legislation and regulations relating to the execution of division programs and performance of delegated duties; provides policy level guidance to the Chief, Conservation Division, and technical guidance to Conservation Managers on matters pertaining to the interpretation of laws and regulations governing the execution of division programs and delegated duties; and is responsible for reviewing and revising, when appropriate, all actions related to appeals from decisions of various division, Survey and Departmental officials.

(2) The Office of the Administrative Officer consists of the Administrative Officer and his immediate staff, the Administrative Section and the General Services Unit. The Office of the Administrative Officer provides staff assistance to the Division Chief and Associate Division

Chief in all administrative matters; directs the Administrative Section and the General Services Unit; influences management decisions through continuing participation in basic management processes; and provides technical advice and assistance to Conservation Managers on matters pertainin to administrative functions, including finance, personnel, procurement, property, audit, management operations and management research.*

*B. The Office of the Assistant Division Chief for Operations consists of the Assistant Division Chief for Operations, the Branch of Mining Operations Office, the Branch of Onshore Oil and Gas Operations Office, the Branch of Marine Oil and Gas Operations Office, the Royalty Accounting Section and the Operations Standards and Directives Section. The Office of the Assistant Division Chief for Operations provides staff assistance to the Office of the Division Chief in the development and implementation of programs relating to the regulation and supervision of operations of oil and gas leases, geothermal resource leases, and mining permits and leases on Federal, Indian, and Outer Continental Shelf (OCS) lands; develops accounting standards, procedures, and instructions and maintains royalty control accounts; develops technical operating standards and procedures; and provides technical guidance in the execution of the Division's responsibilities in these areas of activity.

(1) The Branch of Onshore Oil and Gas Operations Office consists of the Chief of the Branch and his immediate staff. The Branch of Onshore Oil and Gas Operations Office provides headquarters staff leadership in the development of standard criteria, and regulations for the supervision of operations on Federal and Indian oil and gas and geothermal resource leases; provides policy level guidance to the Chief, Conservation Division, and technical guidance to Conservatio Managers on matters pertaining to the development of oil and gas and geothermal resources on Federal and Indian lands; and maintains a system of controls to assure program balance between regions and the highest quality performance in all areas of responsibility in the oil and gas and geothermal resource lease management programs.

(2) The Branch of Marine Oil and Gas Operations Office consists of the Chief of the Branch and his immediate staff. The Branch of Marine Oil and Gas Operations Office provides headquarters staff leadership in the development of standards, criteria and regulations for the supervision of operations on the Outer Continental Shelf under oil and gas and sulfur leases; provides policy level guidance to the Chief, Conservation Division, and technical guidance to Conservation Managers on matters pertaining to the development of OCS oil and gas and sulfur resources; and maintains a system of controls to assure program balance nationally and the highest quality performance in all areas of responsibility in the Outer Continental Shelf oil and gas and sulfur lease management programs.

(3) The Branch of Mining Operations Office consists of the Chief of the Branch and his immediate staff. The Branch of Mining Operations Office provides headquarters staff leadership in the development of standards, criteria, and regulations for the supervision of operations on Federal and Indian mining leases and permits; provides policy level guidance to the Chief, Conservation Division, and technical guidance to Conservation Managers on matters pertaining to the development of leasable Federal and Indian mineral resources (other than oil, gas, and geothermal resources); and maintains a system of controls to assure program balance across the United States and the highest quality performance of all areas of responsibility in the mining lease and permit management programs.*

*C. The Office of the Assistant Division Chief for Resource Evaluation consists of the Assistant Division Chief for Resource Evaluation, the Branch of Onshore Resource Evaluation Office, the Branch of Marine Resource Evaluation Office and the Branch of Mineral and Water Classification Office. The Office of the Assistant Division Chief for Resource Evaluation assists the Division Chief's office in the development of national programs for the geologic mapping, evaluation, classification, and inventory of the leasable mineral and geothermal resources of public, acquired, Outer Continental Shelf, and Indian lands, and

reservoir and waterpower sites on public lands; provides technical guidance to Conservation Managers on matters pertaining to the classification and evaluation of leasable minerals and geothermal resources and water development potential of Federal and Indian lands and the determination of fair market value of resources offered for lease by competitive bidding.

(1) The Branch of Onshore Resource Evaluation Office consists of the Chief of the Branch and his immediate staff. The Branch of Onshore Resource Evaluation Office provides headquarters staff leadership in the conduct of the mineral resources evaluation programs relative to onshore Federal and Indian lands; provides policy level guidance to the Chief, Conservation Division, and technical guidance to Conservation Managers on matters pertaining to the resource evaluation and inventory of oil and gas, geothermal resources, coal, oil shale and other leasable minerals on public and acquired Federal lands and Indian lands, and fair market value determinations of leasable minerals on Federal and Indian lands; and maintains a system of controls to assure program balance between regions and the highest quality performance in all areas of division responsibility in resource evaluation and resource management programs relating to Federal and Indian onshore lands.

(2) The Branch of Marine Resource Evaluation Office consists of the Chief of the Branch and his immediate staff. The Branch of Marine Resource Evaluation Office provides headquarters staff leadership in the conduct of resource evaluation programs relating to submerged lands of the Outer Continental Shelf; provides policy level guidance to the Chief, Conservation Division, and technical guidance to Conservation Managers on matters pertaining to the resource evaluation, inventory of oil and gas and other minerals, and fair market value determinations of resources of submerged lands of the Outer Continental Shelf offered for lease; and maintains a system of controls to assure program balance between regions and the highest quality performance in all areas of division responsibility in resource evaluation and resource management programs on the submerged lands of the Outer Continental Shelf.

(3) The Branch of Mineral and Water Classification Office consists of the Chief of the Branch and his immediate staff. The Branch of Mineral and Water Classification Office provides headquarters staff leadership in the conduct of the mineral land classification programs on Federal and Indian lands; and the programs for the classification of Federal land for waterpower and reservoir sites; provides policy level guidance to the Chief, Conservation Division, and technical guidance to the Conservation Managers on matters pertaining to geological mapping and the mineral land classification programs and the programs for the classification of public and acquired lands for waterpower and reservoir sites; and maintains a system of controls to assure program balance between regions and the highest quality performance of program responsibilities.*

*D. The Office of the Assistant Division Chief for Programs consists of the Assistant Division Chief for Programs, his immediate staff, the Program Planning and Budgeting Section, the Systems Analysis and Development Section, and the Environmental Analysis Section. The Office of the Assistant Division Chief for Programs provides staff assistance to the Office of the Division Chief in program planning and analysis, budget preparation and execution, systems analysis and development, preparation of environmental impact analysis, review and coordination of analysis prepared by others, economic and statistical analysis and reporting, development and coordination of Division employee training programs, generation of briefing and informational materials, and the development of nontechnical publications on Conservation Division activities directed at the layman's level for general public distribution.

(1) The Program Planning and Budgeting Section consists of the Program Officer and his staff. The Program Planning and Budgeting Section provides headquarters staff leadership in program planning and analysis (including the review of available options and the establishment of priorities in the initiation of new programs), budget preparation and execution, and development and coordination of employee training programs, provides policy level

guidance to the Chief, Conservation Division, and technical assistance to Conservation Managers on program planning and analysis, budget preparation and execution and employee training and economic and statistical analysis and reporting programs; and maintains a system of controls to assure program balance between regions and the highest quality of performance in all areas of program planning and analysis, budgeting, and employee training.

(2) The Systems Analysis and Development Section consists of the Staff Engineer, Section Chief and his assistants. The Systems Analysis and Development Section provides headquarters staff leadership in systems analysis and development; provides policy level guidance to the Chief, Conservation Division, and technical assistance to Conservation Managers on systems analysis and development.

(3) The Environmental Analysis Section consists of the Staff Assistant, Section Chief, and his assistants. The Environmental Analysis Section provides headquarters staff leadership in preparation of environmental impact analyses and in the review and coordination of environmental analyses prepared by others, provides policy level guidelines to the Chief, Conservation Division, and technical assistance to Conservation Managers on the need for and the preparation of environmental impact analyses and the review and coordination of Division input into environmental impact analyses prepared by others.*

*.3 Field Organization. The field organization of the Conservation Division consists of four Conservation Manager Offices, (each of these offices is responsible for those operational activities of the Conservation Division which take place within its geographically-defined area of jurisdiction), seven Area Oil and Gas Supervisor Offices, seven Area Mining Supervisor Offices, eight Area Geologist Offices, two Area Hydraulic Engineer Offices, and one Area Geophysicist Office, (each of the afore-listed Area offices is responsible for those activities of the Conservation Division which fall within its programmatic area of responsibility that take place within its geographically-defined area of jurisdiction). Where work load and distance warrant, district and district inspection

offices have been established to facilitate performance of the programmatic responsibilities which fall within the jurisdiction of an Area office. Three of the Conservation Manager Offices are identified as "regional" offices; their area of jurisdiction conforms to the "regions" established for the functions of the Geological Survey. The fourth Conservation Manager office is identified as the Gulf of Mexico - OCS Operations Office.

A. The Gulf of Mexico OCS Operations Office (headquartered in New Orleans - Metairie, Louisiana) is responsible for all Conservation Division programmatic activities that take place on submerged land of the Outer Continental Shelf in the Gulf of Mexico. It is headed by a Conservation Manager who is responsible, at the same level and under the same program direction as the other Conservation Managers described below, for execution and coordination of the Conservation Division's Gulf of Mexico program, involving:

(1) Supervision of operations and activities for the exploration, development, and production of oil, gas, sulfur, and other minerals leasable under the OCS Lands Act in accordance with operating and other regulations and orders;

(2) Supervision of the determination from pertinent geological, geophysical, and engineering data and evidence of the actual or probable presence of mineral deposits of value in specific tracts or areas, the calculation of reserves, the determination of fair market value of tracts offered for lease, and the analysis of environmental factors relating to safe, orderly development.

B. Each Regional Conservation Manager Office is headed by a Conservation Manager who is responsible for execution and coordination of those programmatic activities of the Conservation Division which take place within his area of jurisdiction. Such activities involve:

(1) Supervision of operations and activities for the discovery, development, and production of oil and gas from leases on Federal, Indian, OCS and certain Naval Petroleum Reserve lands subject to the various mineral leasing laws, and administers geothermal resources operating regulations;

(2) Supervision of operations and activites for the discovery, development, and production of various minerals and solid fuels under leases on Federal and Indian lands, subject to the various leasing laws and operating regulations;

(3) Determination from pertinent geological data and evidence of the actual or probable presence of mineral deposits of value in specific tracts or parcels of public land, the protection of such mineral estates (by timely notice, withdrawal, or classification) from inadvertent disposal under nonmineral land laws;

(4) Promotion of the exploration and development of mineral estates under applicable provisions of the Federal mining or mineral leasing laws;

(5) Provision of the administrative and supervising agencies involved in the development of mineral estates of Federal and Indian lands with the geologic determinations and counsel requisite to the effective discharge of such agencies responsibilities;

(6) Identification and classification of potential water power and water storage reservoir sites;

(7) Protection of water power and reservoir sites on Federal land by initiation of formal classification thereof and forestalling encumbrancing of such sites by furnishing data and recommendations concerning other uses of classified lands;

(8) Continued review and revision of land classifications;

(9) Preparation for publication and for administrative use of maps and reports on the results of scientific investigations;

(10) Representation of the Conservation Division on the Survey Committee for the Region;

(11) Responsibility for Conservation Division activities in liaison with the Survey Assistant Director for the Region; and

(12) Advice to Geological Survey representatives on Departmental field committees and on interagency groups.

C. Geographic Area of Jurisdiction of Conservation Manager Offices (Regional).

(1) Western region (headquartered at Menlo Park, California) includes the States of Alaska, Arizona, California, Hawaii, Idaho, Nevada, Oregon, Washington, and the Outer Continental Shelf lying seaward of said states.

(2) Central region (headquartered at Denver-Lakewood, Colorado) includes the States of Arkansas, Colorado, Iowa, Kansas, Louisiana, Missouri, Montana, Nebraska, New Mexico, North Dakota, Oklahoma, South Dakota, Texas, Utah, and Wyoming.

(3) Eastern region (headquartered at Washington, D. C.) includes all other States of the United States, Puerto Rico, Virgin Islands, and the Outer Continental Shelf of the Atlantic Ocean.*

United States Department of the Interior

GEOLOGICAL SURVEY
RESTON, VIRGINIA 22092

OFFICE OF THE DIRECTOR

October 24, 1974

Memorandum

To: Line Supervisors, Conservation Division

Through: Chief, Conservation Division

From: Director, U. S. Geological Survey

Subject: Conservation Division Objectives

The onshore lease management study underway during the past several months is now well advanced and is showing the need to develop and strengthen many supervisory and evaluation procedures. We here at headquarters and I am sure you on the line have known for some time that significant changes and much more staff are needed to bring our operations into full conformance with Departmental and Survey objectives and policy, but until now we have lacked the documentary and fiscal support necessary to bring this about.

No doubt it will take time to bring about the necessary changes, but in the meantime our operations should aim to the maximum possible extent to achieve the following policies and objectives:

1. Orderly and timely resource development, with prevention of waste in the extraction of mineral resources.

2. Protection of environmental quality and the achievement of exemplary practices in mining on the public lands.

3. Return of fair resource value to the public.

4. Impartial application of laws, regulations, and orders to lease operations.

For the source of these policies, see the Departmental and Survey Manuals, Secretarial Order No. 2948, and my Administrative Digest letter of April 26, 1973.

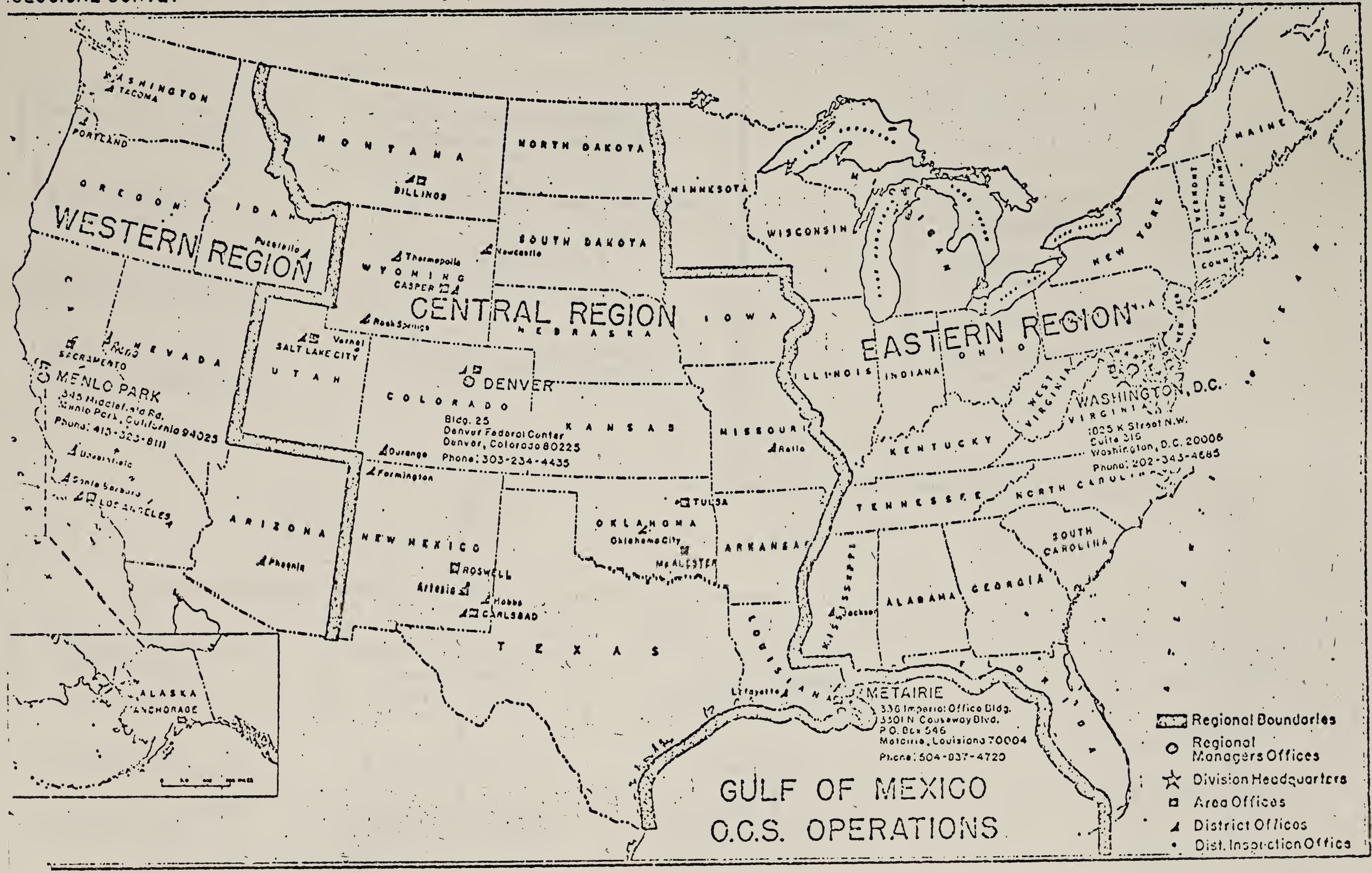
These objectives, of course, may at times be conflicting, but none of them can be sacrificed for the benefit of the others. Achieving

a satisfactory resolution of conflicts requires wisdom, imagination, and impartiality. Fortunately, this combination often yields a fully acceptable solution--and this is what we must aim for.

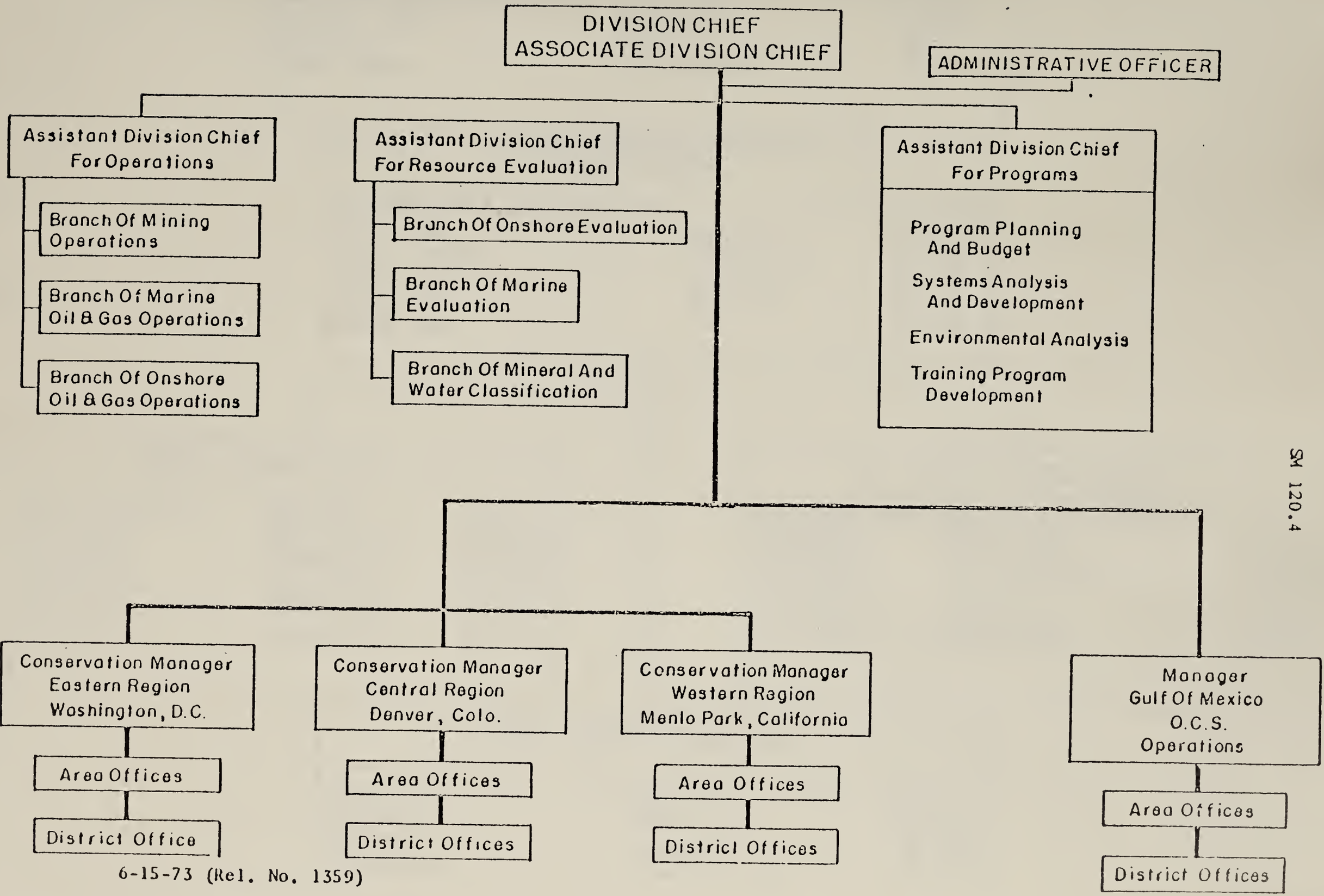
Among the varied activities within the Geological Survey, I see yours at the top of the list in their importance to the Nation, their difficulty, and in the challenge they offer to those recognizing the need for the Nation to meet its resource needs while at the same time maintaining a quality environment and serving the public interest wisely and well in the management of its resources. We are now entering a period in which it seems likely that we will receive the increased fiscal support necessary to improve our ability to carry out our responsibilities, and in the months ahead we must work together to find, develop, and implement the procedures for doing so.

V. E. McKelvey

cc: Senior Scientist - 103
AstDir--Env. Conserv. - 106
AstDir--ER - 171


WASHINGTON
TACOMA
PORTLAND
OREGON
IDAHO
MONTANA
BILLINGS
NORTH DAKOTA
MINNESOTA
WESTERN REGION
SOUTH DAKOTA
Thermopolis
WYOMING
CASPER
Newcastle
Rock Springs
CENTRAL REGION
NEBRASKA
IOWA
WISCONSIN
MICHIGAN
NEW YORK
MAINE
EASTERN REGION
NEVADA
SACRAMENTO
Vernal
SALT LAKE CITY
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P.O. Box 546
Metairie, Louisiana 70004
Phone: 504-837-4720
Regional Boundaries
Regional Managers Offices
Division Headquarters
Area Offices
District Offices
Dist. Inspection Office

GEOLOGICAL SURVEY
ORGANIZATION – CONSERVATION DIVISION



SM 120.4

6-15-73 (Rel. No. 1359)

PACIFIC AREA GEOLOGIST (Menlo Park)

Supv Phys Scientist	(Cullins-15)	GS-14/15
Asst. Area Geologist	(Stephens-14)	GS-13/14
Geologist (Marine Minerals)	(Hess-13)	GS-13
Phys Sci Tech	(Fedewa-5)	GS-5/7
Secretary	(Wells-6)	GS-6
Clerk Typist	(Irissarry-3)	GS-3/4

ONSHORE EVALUATION SECTION (Menlo Park)

*SECTION CHIEF, Supv Geologist		GS-13/14
Carto Tech	(Thury-7)	GS-7
Clerk Typist	(Johnson-4)	GS-4/5
*Clerk Typist	Cates-3	GS-3/4
Carto Tech	(Blank-5)	GS-4/5
Carto Tech		GS-4/5

ENERGY RESOURCES UNIT

*Supv Geologist	(Lee-13)	GS-13
Geologist	(Dockter-9)	GS-9/12
Geologist	(Simoni-9)	GS-9/12
Geologist	MOORE-7	GS-7/12
Geologist	(Brook-12)	GS-9/12
Geologist	SOLOMON-7	GS-7/12

NON-ENERGY RESOURCES UNIT

*Supv Geologist	(Oberlindacher-13)	GS-13
Geologist	(Calzia-12)	GS-9/12
Geologist	(Crowley-12)	GS-9/12
Geologist	Kamiyoshi-11	GS-9/12
Geologist	Miller-7	GS-7/12
Geologist	(Hovland-9)	GS-7/12

MINERAL CLASSIFICATION UNIT

*Geologist	(Sun-13)	GS-13
Geologist	(Smith-12)	GS-9/12
Geologist	VILLALOBOS-7	GS-7/12
Geologist	Throckmorton-7	GS-7/12

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Supv Ph
*Miner
Secr
Cl

GS-14
GS-11/12
GS-4/5
GS-3/4
GS-3/4

GS-3

ETING UNIT

9)
*AD

GS-9
GS-5/6
GS-5/6
GS-5/7

SELECTION & EVALUATION SECTION

(LOS ANGELES)

v. Phy.Sci(Ballentyne)GS-13

witz-4)

GS-4/5
GS-3/4

OCS DATA ACQUISITION & ANALYS
(Los Angeles)

ction Chief, Supv Geol/Geophy
logist (Paleontologist)
logist/Pet Engr (Log Analyst)
erk (Typing)
erk Typist
logist

RESERVES AND
IZATION UNIT

TRACT SELECTION AND
EVALUATION UNIT # 2

Geoph

(Bird-13)
rnandez-11)
ensky-12)
re-12)

(Bickel-11)

(Dreessen-11)

ttene-12)

GS-13
GS-9/12
GS-9/12
GS-9/12
GS-11/13
GS-7/12
GS-7/12
GS-5/7

DISTRICT GEOLOGIST (Los Angeles)

Supv Phys Sci	(Yenne-14)	GS-14
*Mineral Economist		GS-11/12
Secretary	(Vince-5)	GS-4/5
Clerk Typist		GS-3/4
Clerk Typist		GS-3/4
*Clerk Typist	(Hayes)	GS-3

ADP UNIT

*ADP Math Programmer	(Kulpa-11)	GS-7/11
*Computer Aide/Tech		GS-4/9
*Computer Aide/Tech		GS-4/9

DRAFTING UNIT

Carto Tech	(Engler-9)	GS-9
Carto Tech	(Nord-5)	GS-5/6
Carto Tech	(Leetch-5)	GS-5/6
*Carto Tech		GS-5/7

OCS DATA ACQUISITION & ANALYSIS SECTION (Los Angeles)

*Section Chief, Supv Geol/Geophy	(Fouda-14)	GS-13/14
*Geologist (Paleontologist)	(Roberts-12)	GS-12/13
*Geologist/Pet Engr (Log Analyst)		GS-12/13
*Clerk (Typing)		GS-4/5
*Clerk Typist	(Spiegle-3)	GS-3/4
Geologist		GS-7/11

ONSHORE OIL & GAS SECTION

*Geologist	(McDonald-12)	GS-13
Geologist		GS-9/12
*Phys Sci Tech		GS-5/7
*Research Geol	Smith	GS-13

OCS TRACT SELECTION & EVALUATION SECTION (LOS ANGELES)

*Section Chief, Supv. Phy.Sci	(Ballentyne)	GS-13
Clerk (Typing)	(Kantrowitz-4)	GS-4/5
Clerk Typist		GS-3/4

FIELD RESERVES AND UNITIZATION UNIT

*Supv Geol/Pet Engr	(Bird-13)	GS-13
Geologist	(Fernandez-11)	GS-9/12
Geologist	(Prensky-12)	GS-9/12
Geologist	(Lore-12)	GS-9/12
*Pet Engr	(Ibrahim-12)	GS-11/13
*Geophysicist	(Phair-11)	GS-7/12
*Phy. Sci. Tech.		GS-5/7
*Geologist		GS-9/12
Geologist		GS-9/12
Phy. Sci. Tech.		GS-5/7

DATA ACQUISITION AND GEOLOGIC HAZARD UNIT

*Supv Geophy/Geol	(Morris-13)	GS-13
Geophysicist	(Krotser-12)	GS-7/12
Geophysicist	Kalil-11	GS-7/12
Geophysicist		GS-7/12
*Pet Engr	(Tudor-12)	GS-7/12
Geologist	(Owen-11)	GS-9/12
Geologist	Kalil-12*	GS-9/12
*Phy. Sci. Tech.		GS-5/7
Phys Sci. Tech		GS-5/7

TRACT SELECTION AND EVALUATION UNIT # 1

*Supv. Geol/Geoph	(Griggs-13)	GS-13
Geologist	(Webster-12)	GS-9/12
Geologist	(Sundin-11)	GS-9/12
*Pet Engr		GS-11/13
Geophysicist	(Kalra-12)	GS-7/12
Geophysicist	(Harris-9)	GS-7/12
Geophysicist		GS-7/12
*Phy Sci Tech		GS-5/7

TRACT SELECTION AND EVALUATION UNIT # 2

*Supv. Geol/Geoph		GS-13
Geologist	(Bickel-11)	GS-9/12
Geologist		GS-9/12
Geologist	(Dreessen-11)	GS-9/12
*Pet Engr		GS-11/13
Geophysicist	(Slettene-12)	GS-7/12
Geophysicist	(Stinson-9)	GS-7/12
*Phy Sci Tech		GS-5/7

The Conservation Division
U. S. Geological Survey
Department of the Interior

The Conservation Division was organized July 1, 1925, and has two primary functions. These are (1) the classification of Public lands as to their mineral character, their value for waterpower and storage purposes, and the evaluation of mineral tracts subject to competitive lease; and (2) the supervision of operations incident to the prospecting, development, and production of minerals on Federal, Indian, Naval Petroleum Reserve Lands and the Outer Continental Shelf under lease, license, and prospecting permits. Both functions are concerned with the identification, efficient development, maximum recovery and prudent use of mineral and water resources belonging to the United States, or to Indians, and neither is performed by any other Government agency.

The classification function, carried out by Area Geologists and Hydraulic Engineers, is performed pursuant to the provisions of the Act of March 3, 1879 (20 Stat. 377), which created the Geological Survey and charged its Director with the responsibility of classifying the Public Lands of the United States. The second-named function, carried out by Area Oil and Gas Supervisors and Area Mining Supervisors, with support from Area Geologists and Geophysicists, is performed in accordance with the provisions of the various mineral leasing laws and applicable regulations under authority delegated from the Secretary of the Interior.

Functions of Area Offices

Area Geologists. The functions of the Area Geologists include offices and field activities for: (1) inventory of mineral resource data as to thickness, quality, depth, and extent of leasable minerals for use in Federal land administration and mineral management; (2) translation of leasable mineral resource data for determinations involving multiple-use, exchange, surface interference, disposal or retention of mineral rights and areas subject to competitive leasing onshore; (3) provide the geologic interpretations and analyses necessary for pre-sale evaluation of lands to be offered for competitive leasing to assure receipt to the Government of fair value for the mineral resources disposed of; (4) review of geologic information from Federal permittees and lessees, and independent geologic investigations to supplement existing

data for the classification and evaluation of Federal and, when requested, Indian lands; (5) geologic review of applications to lease, explore and develop Federal mineral lands; (6) study of geologic data on leased lands for purposes of inventory and development; (7) provide Federal land-administering agencies with determinations and consultation as to the classification and evaluation of the Federal mineral estate for leasable minerals and as an advisory service with regard to the occurrence of locatable minerals on Federal lands; and (8) release or publish all pertinent (non-proprietary) mineral classification and evaluation data of a geologic nature of interest and value to the scientific community, industry, and public-at-large.

Upon recommendation of the Director, Geological Survey, and under authority contained in the 1879 Survey Organization Act, the President of the United States, pursuant to the Act of June 25, 1910, withdrew approximately 100,000,000 acres for classification purposes believed to contain valuable nonmetalliferous minerals in 16 states and Alaska. Much of this acreage has subsequently been classified or restored. As of December 31, 1972, there were outstanding withdrawals of 20,590,000 acres for coal, 14,206,000 acres for oil shale, 1,620,000 acres for phosphate, and 9,411,000 acres for potash. The Conservation Division has also classified 40,843,000 acres of coal land, 4,000 acres of oil land, 4,081,000 acres of oil-shale lands and 390,000 acres of phosphate land, in addition to the amount of acreage withdrawn.

Under the mineral leasing laws, the Area Geologists determine and define the "Known Geologic Structure" (KGS) of producing oil and gas fields as the basis for discrimination between lands subject to lease on application or by competitive bidding, respectively and determine for each oil and gas lease application that the land sought is or is not within the KGS of a producing field. As of December 31, 1972, there were 727 producing oil and gas structures involving 11,801,905 acres in 18 states defined as KGS. For every plan of unit operation or cooperative development submitted, a determination of the area properly subject geologically to inclusion therein and a specification of the required depth for an adequate test of such area are provided. There was a total of 903 unit plans outstanding on December 31, 1972, involving 7,611,277 acres, and a total of 1,327 terminated containing 30,749,321 acres. First discoveries of oil and gas under application leases, and discoveries of new oil or gas fields or deposits pursuant to the Act approved December 24, 1942 (56 Stat. 1080), are appraised and reported by the Division to the Bureau of Land Management for their pertinent effect on rent and royalty liabilities.

The Area Geologist determines the quantity, thickness, depth, extent, quality, and pitch of minerals and mineral deposits occurring in land tracts offered for competitive lease and provides geologic analysis of land subject to prospecting in accordance with the mineral leasing laws. Area Geologists advise as to the validity of geologic data known or

proffered in support of mineral discovery . Federal lands. During the exploratory and exploitation phases of mineral recovery the Area Geologist determines surface and subsurface geologic hazards and conditions likely to be encountered in the development of oil, gas, geothermal, and mining leases; and informs Division officials through appropriate geologic reports.

The geologic investigation of dam sites in cooperation with area Hydraulic Engineers is also a function of the Area Geologist. The Area Geologist provides for constant geologic guidance of Area and Regional officials of the Conservation Division and is a part of the Division network maintained for the Secretary of the Interior to provide for the continuous service of consulting geologists on problems of Public Land Administration.

Area Hydraulic Engineers. Activities required of the Area Hydraulic Engineers in the performance of their function to classify the Public Lands as to their waterpower and water storage possibilities include field investigations necessary for the collection of basic data on water resources, topographic and geologic characteristics; office investigations incident to the preparation of related maps and reports; the classification of lands that have potential for purposes of waterpower development or water storage; the elimination from classification lands found to be improperly classified for power or storage purposes; the processing of applications for rigths-of-way on or across Public Lands classified for reservoirs, power structures, conduits, canals, transmission lines, or other related uses; the recommendation of appropriate action to be taken by the Federal Power Commission on petitions for determinations under section 24 of the Federal Power Act; the preparation and submission of reports to the Bureau of Land Management on the waterpower or water-storage value of lands sought under a variety of Public Land Laws; and the furnishing to State and Federal agencies, individuals, and corporations concerned with the conservation and development of water resources, pertinent data bearing on the problems of waterpower, irrigation, flood control, navigation, and water supplies for municipal and industrial use in the Public Land states. As of December 31, 1972, a total of 14,296,781 acres of Public Land in 21 states had been classified as valuable for water resource development purposes, subject to use or disposal under appropriate legislative and administrative authority.

Area Oil and Gas Supervisors. The Area Oil and Gas Supervisors oversee industry operations for the prospecting, development, and production of crude oil, natural gas, and products extracted from natural gas on leased Federal, Indian, certain Naval Petroleum Reserve Lands, and on the Outer Continental Shelf.

The duties of the Area Supervisors inclu the advance approval of development plans and operating procedures; the periodic inspection of leased properties to assure orderly and efficient development of oil and gas deposits through proper engineering control and laboratory assistance, and the maintenance of proper records of production; the enforcement of Federal regulations to assure orderly development, best engineering practices, prevention of waste and safety and welfare of workmen; the accumulation and correlation of stratigraphic, geologic, production, and graphic records for use in engineering studies: the study and development of improved production techniques applicable to any given field to assure optimum production rates and to prevent underground waste of oil and uneconomical expenditure of reservoir energies; the analysis of oils, gases, waters, cores, etc., in furtherance of such engineering endeavor; and the determination and collection of the royalty liability of each producer.

Area Mining Supervisors. Activities required of the Area Mining Supervisors in the performance of their functions of supervising operations and activities concerned with the prospecting, development, and production of various minerals, fuels, and fertilizers on Public, Indian, and Acquired lands subject to the various mineral leasing laws, include advance approval of operating plans and procedures and deviations therefrom; field inspections for the measurement of and the accounting for all minerals produced to assure a proper determination of royalty liabilities; periodic visits to effect the enforcement of regulations governing mining and milling methods and the safety and welfare of employees; field investigations and studies looking to the improvement of recovery and milling practices; the estimation of the reserves of coal and other minerals in Public Lands; the preparation of engineering reports and recommendations as to leasing matters for guidance of appropriate administrative officials in the Interior Department; and the provision of a general consulting service on the coal, potash, sodium, and phosphate resources of the public domain to the officials of numerous Federal agencies.

Indian Lands. The Conservation Division, in addition to furnishing technical advice to the many agency superintendents and the Office of Indian Affairs, performs for that bureau supervisory duties under leases issued for restricted Indian Lands similar to the duties it performs under leases for Public Lands. In addition to coal, oil, gas, and other minerals subject to lease under Public Land laws, the Indian Land laws provide for leasing of metalliferous and nonmetalliferous minerals generally. The lode and placer laws are not applicable to Indian Lands. Accordingly, the Survey has under supervision leases for such minerals as asbestos, bentonite, copper, gilsonite, gold, guano, lead, limestone, marl, silver, tungsten, vanadium, vermiculite, and zinc. In general, the conservation practices adopted for use on Public Lands are applicable on Indian Lands also and have the same beneficial results irrespective of the particular

Acquired Lands. The President's Reorganization Plan No. 3 of 1946 transferred to the Department of the Interior jurisdiction over mineral deposits on lands (generally designated as Acquired Lands) held by the Department of Agriculture. Subsequently, the Act of August 7, 1947 (61 Stat. 913), provided authority to lease the nonmetalliferous minerals on such lands as well as most other acquired lands and extended the mineral leasing law (Act of February 25, 1920, as amended) to the Acquired Lands. The Conservation Division discharges the same responsibilities for classification and supervision on Acquired Lands as maintained on Public Lands. In addition, there are applicable regulations for the leasing of metallic minerals on certain of the Acquired Lands transferred to this Department under Reorganization Plan No. 3 of 1946.

Naval Petroleum Reserve Lands. In addition to the work relating to leasing and supervision on Public, Indian, Acquired, and Outer Continental Shelf Lands, the Conservation Division, by cooperative arrangement with the Department of the Navy, furnishes technical advice and supervises operations for the drilling and production of oil and gas in Naval Petroleum Reserves, except Reserve No. 1 (Elk Hills). Also, the Conservation Division is called upon by many other departments for technical advice prior to leasing or disposal of lands valuable for minerals and oil and gas.

Outer Continental Shelf Mining. The Outer Continental Shelf Lands Act provides for the issuance of leases for the mining of minerals other than oil, gas, and sulfur for the OCS. No leases are currently in effect, but regulations are drafted and the environmental impact of offshore mining is under study.

Staff Meeting
Area Geologist's Office

April 11, 1977

The following information is the latest we have on the reorganization. As more information becomes available, we will let you know.

Reorganization Guidelines

Drafting, typing, Hess, Cresswell, remain directly supervised by the Area Geologist.

Energy Unit	Non-Energy Unit	Classification
Lee (Supervisory Geol)	Oberlindacher (Supervisory Geol)	(Vacant)
Sun		Smith
Brook	Calzia	Fernandez
2 Geol. vac.	Crowley	Osvald
Solomon	Hovland	Shimamoto
PST	Geologist	
	PST/PSA	

(There's always a possibility you will transfer around).

Go to your unit head for questions. If additional assistance is needed, then go to the Area or Assistant Area Geologist.

Unit heads have the following duties: approving leave, OC and BPA purchases; okaying field work; assigning work to the summer aids, PST's and PSA's. You will request promotions from your unit head.

The Area Geologist will still approve the following: travel vouchers, travel authorizations, publications, controlled property (9-064).

Attendance at meetings are approved by Reston.

Approval for training - Up to $100 - Area Geologist
$100-250 - Acting Conservation Manager
$250 and up - Reston

Next three years

Elko, NV. (oil shale)
Succer Creek, Oregon-Idaho (Na^+)
Hawley Creek, Idaho (P_2O_5)
Lower Valley, Idaho (P_2O_5)
KLA establishment

*Montello, Nevada
*So. end Pequops, Nevada
*Coaldale, Nevada (K_2O + coal)
Alunite investigations (K_2O + Al)
Environmental input

*Will need formal project descriptions and approval.

Classification

1. California desert study
2. BLM/GS Min. Apps.
3. 2° classification maps
4. Damsites (Oregon, California)
5. Review literature for mineral card preparation and maintenance
6. Review and action on withdrawals
7. Process coops
8. Review minutes and provide other editorial services
9. Maintain classification maps (1:500,000)
10. ADP functions

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
Conservation Division
Area Geologist's Office
345 Middlefield Road
Menlo Park, California 94025

September 9, 1977

Memorandum

To: Menlo Park Personnel, Office of the Pacific Area Geologist

From: Area Geologist, Pacific Area

Subject: Reporting to Unit Supervisors

In order to help keep our new unit supervisors better informed about the activities of the personnel in the unit for which they are responsible, we have requested that the supervisors initial all timesheets before they are submitted to the timekeeper. They will be responsible for assuring that all project numbers are valid and appropriate for the work performed. They also will be responsible for insuring the validity of all overtime indicated, so make sure they are informed before the extra work is performed.

Smith, Throckmorton, Villalobos, and Hicks should report to Stanley Sun. In the absence of the Onshore Evaluation Chief, Johnson, Oates, Thury, Blank and the new carto tech will also report to Stanley. Dockter, Simoni, Moore, Brook, and Solomon should report to Bill Lee. Calzia, Crowley, Kuniyoshi, Miller, and Hovland should report to Peter Oberlindacher. Hess, Fedewa, Wells, and Irissarry should report to Vern Stephens or to me. If your unit supervisor is absent on timesheet day or when you wish to request overtime, you should report to Vern or to me.

To further aid in the exchange of information, you should route your monthly reports through the same supervisors. They will be responsible for insuring that all output is accurately reported and that appropriate statements are included in the narrative portion of the report.

Henry L. Cullins



Leasable Mineral Value Determinations

History of Mineral Land Custom and Legislation

During the Middle Ages under early Germanic law, the miner enjoyed unusual liberty in that he was free to stake out mining claims on waste land based on charter granted by the feudal overlords and the customs of the area. Right to the use of water, rights of way for access, and timber for buildings were included. Payment of a royalty was made and a small rent. The Germanic custom of free mining influenced English mining law, and apart from the concept of the Royal mine by which gold and silver were the exclusive property of the crown, mines in England belonged to the owner of the freehold. In general these laws and traditions were transplanted to the mining areas of the United States.

The original 13 colonies obtained title to their land under colonial grants from the King. Most of the charters granted title to the mines subject to rent. In 1785 the Continental Congress passed "An Ordinance for Ascertaining the Mode of Disposing of Lands in the Western Territory" which made provision for the sale of land but reserved "one third part of all gold, silver, lead and copper mines to be sold or otherwise disposed of as Congress shall hereafter direct". After the Revolution, the public lands were regarded as a potential source of funds for paying the war debts and three sales were made before organization of the present government March 4, 1789. This policy was continued by the first general act passed in 1796 (1 Stat. 469) which provided for the sale of agricultural lands in Ohio, and established a system of rectangular surveys. A statute in 1800 also authorized the sale of land with a right to purchase on credit. This system failed miserably and was abandoned in 1820 after a series of statutes relieving debtors of their defaults.

After 1830, Congress adopted the policy of encouraging settlement and development of the public domain rather than raising money from its sale. The result was the passage in 1841 of the General Pre-emption Act which provided citizens who settled upon and improved surveyed public land to enter 160 acres or less at a minimum price of $1.25 per acre. This was not successful and the policy of sale for revenue was terminated by The Homestead Law, May 20, 1862 (Rev. Stat. 2289-2303) which provided for the outright transfer of title to settlers who complied with certain conditions regarding residence, cultivation, and use. This law was amended by a number of subsequent acts. During this period, mineral policy was essentially that of free-mining, based largely on local mining customs which had attained the force of law in the mining camps on the public domain, and the promotion of mineral development. The first statute was the Mining Law of 1866 which applied to lodes or veins bearing "gold, silver, cinnabar or copper". It confirmed existing mining claims and authorized patenting of lode locations. It stated, ". . . the mineral lands of the public domain, both surveyed and unsurveyed, are hereby declared to be free and open to exploration by all citizens of the United States". This act stimulated development of the mineral resources of the west, and although its provisions have been largely superceded, it has continued to be the basic policy of federal mining legislation. The mining laws finally were formalized in the Act of May 10, 1872 (Rev. Stat. 2319) which provides

that "all valuable mineral deposits in lands belonging to the United States both surveyed and unsurveyed, are hereby declared to be free and open to exploration and purchase, *** by citizens of the United States and those who have declared their intention to become such". At that time, interest was principally in the metalliferous minerals and the laws were framed with such in mind, provision being made for both lode and placer claims. The placer law, July 9, 1870 (16 Stat. 217) was intended to apply to gold and silver distributed through deposits of sand and gravel. By the Act of August 4, 1892 (27 Stat. 348), the placer law was extended to apply to lands chiefly valuable for building stone, and by later acts it was made to apply to oil and gas, salines and other minerals. Coal land was sold under the coal land law approved March 3, 1873 (17 Stat. 607). Under these laws and by grants to states, railroads, and for reclamation, much valuable mineral land passed into state and private ownership.

By the end of the 19th Century, however, public sentiment for conservation of our natural resources was building up, and in 1891 Congress authorized the President to withdraw land for the forest reserves. A national conservation commission was formed in 1909 to inventory natural resources, and conservation became a firmly-established national land policy during the Theodore Roosevelt administration and withdrawals of coal-land and oil-and-gas lands were made by Presidential order. Theodore Roosevelt maintained that executive withdrawals were valid under the general supervisory power which the President possessed with respect to public lands of the United States. His successor, Taft, because of his innate conservation asked Congress for blanket approval of withdrawals which was done by the "Pickett Act" or the "Withdrawal Act" (36 Stat. 847 (1910), 43 USC 141-143). Withdrawal under the authority of that act was tested in court and from the decision the President emerged as an executive with broad supervisory powers over the public lands, limited only by expressly declared Congressional policy.

For 10 years Congress made no decision as to what to do with the lands withdrawn for metalliferous location under the Pickett Act, although an Act to authorize exploration for and disposition of potassium was passed October 2, 1917. In August 1919, Senator Smoot introduced a bill that limited land valuable for coal, phosphate, oil, oil shale, gas and sodium to leasing. It became effective February 25, 1920. This system by which title to the land undergoing mineral development would remain with the United States was a complete policy departure from the system under the mining location laws under which the locator might obtain fee title to the land.

Subsequent acts have supplemented the Mineral Leasing Act of 1920. The leasing of sulphur lands in Louisiana was approved in 1926 and in New Mexico in 1932. Leasing for chlorides, sulfates, carbonates, borates, silicates or nitrates of potassium was legislated in 1927. The Taylor Grazing Act of 1934 authorized temporary withdrawals of land valuable chiefly for grazing for classification to determine its highest use. The land continued to be subject to mining location. The Acquired Land Leasing Act was passed in 1947, the Common Varieties Act in 1955, and the Defense Withdrawal Act in 1958.

Interest in the concept of multiple uses of the public land had been growing ever since the withdrawal days. However, mining locations could not be made on lands reported valuable for the leasable minerals, on which application to lease had been filed or on which a lease or permit had been granted until the Potash Leasing Act of 1927 which permitted the location of fissure veins under the mining laws on lands subject to potash leases. Actually the conflict between the mining laws and the leasing act was academic until the uranium boom on the Colorado Plateau in the late 1940's. Uranium ores were found in sedimentary rocks also potentially valuable for oil and gas. It has been estimated that as much as 75 percent of the available uranium lands were already under federal oil and gas leases. The Atomic Energy Act of 1946 complicated the matter by reserving to the United States all fissionable source materials on the public domain and required reservations in all mineral patents. Temporary relief from the difficulty of making valid uranium locations subject to federal oil and gas leases or applications came in 1953 from Public Law 250 which set up a procedure for validating mining claims. A permanent solution was found in Public Law 585, The Multiple Mineral Development Act of August 13, 1954 which provided for validation of previous mining claims, and adjustment of conflicts arising when land is used both for mining and leasing-act operations. The Multiple Surface Use Act enables the government to dispose of surface resources on dormant or spurious mining locations.

Although under the constitution, Congress has almost unlimited power over the public lands of the United States, it never made a formal statement with regard to mineral resources on the federal lands until the Mining and Minerals Policy Act approved December 31, 1970 in which is stated:

The Congress declares that it is the continuing policy of the Federal Government in the national interest to foster and encourage private enterprise in (1) the development of economically sound and stable domestic mining, minerals, metal and mineral reclamation industries, (2) the orderly and economic development of domestic mineral resources, reserves, and reclamation of metals and minerals to help assure satisfaction of industrial, security and environmental needs, (3) mining, mineral, and metallurgical research, including the use and recycling of scrap to promote the wise and efficient use of our natural and reclaimable mineral resources, and (4) the study and development of methods for the disposal, control, and reclamation of mineral waste products, and the reclamation of mined land, so as to lessen any adverse impact of mineral extraction and processing upon the physical environment that may result from mining or mineral activities.

For the purpose of this Act "minerals" shall include all minerals and mineral fuels including oil, gas, coal, oil shale and uranium.

Resource Evaluation in the Conservation Division

Geologic work in the Conservation Division can be divided into four comprehensive categories:

1. Accumulation of basic geologic data
2. Mineral land classification
3. Mineral land evaluation
4. Lease management support

Basic Data Collection

Before any classification or evaluation actions can be executed or any lease management support activities undertaken, an inventory of leasable mineral resources on Public, acquired, Indian, and O.C.S. lands must be made. Information on the thickness, quality, depth and extent of each leasable mineral must be accumulated. This data collection makes up the bulk of our field work, and includes, but is not limited to:

1. Compilation of existing data from:
   a. Published literature, theses, and unpublished reports.
   b. Files of area geologists, area mining supervisors, and other U.S.G.S. offices.
   c. State agencies and industry.
   d. Lithologic and electric logs of tests for oil and gas, water wells and seismic shot holes.
2. Geologic mapping by quadrangle or by strip maps, and geologic examination of specific tracts.
3. Drilling and electric logging to supplement mapping.
4. Collection of samples from formations bearing leasable minerals drilled by tests for oil and gas. (In most wells, beds containing coal and some of the other leasable minerals are at rather shallow depth, and are penetrated before surface casing is set.) Hence Geological Survey personne must be on the rig at the time these beds are drilled, make their own depth measurements and grab their own samples.)
5. Collection and preparation of samples for analyses to determine grade and purity of the material.

From these data, the following maps, charts, and reports can be prepared to furnish bases for the various classification and evaluation actions and lease management support activities:

1. Geologic maps and sketches and cross sections.
2. Isopach maps of beds of leasable material.
3. Structure contour maps.

4. Thickness of cover maps
5. Tables showing chemical composition and quality of each leasable material.
6. Quantity estimates of the resources of each leasable material.
7. Township reports.
8. Reports for publication.

Mineral Land Classification

The classification activities of the Conservation Division are derived from the organic act creating the Geological Survey (March 3, 1879, 20 Stat. 377-394) which charged the Director with "the classification of the public lands, and examination of the geological structure, mineral resources, and products of the national domain." Subsequent statutes that have modified or extended the classification function have been discussed under "History of Mineral Land Custom and Legislation" and are listed in the appendix.

The purpose of classifying the lands as to mineral character is to define the areal and depth limits of each of the leasable minerals and hence be able to make a scientific estimate of the quantity of each resource available. By doing this, the United States can prevent improvident disposal of its mineral estate, conserve natural resources, and assure that the lands are used for as many purposes as possible and to their greatest value.

Classification anticipates and assumes the ultimate coming of conditions favorable for the development and marketing of the commodity. It is not concerned with economic conditions that make feasible the exploitation of the deposit at the present time.

The first step in the classification procedure is the withdrawal of lands containing leasable mineral from entry, exchange or sale under the Withdrawal Act of 1910. Next, classification standards are established for each leasable mineral. Since only the ultimate value of the material is important, these standards set minimum limits on the intrinsic factors of thickness, quality and areal extent and maximum limits on depth.

Classification actions are of two types:

1. Informal classification
   a. Delineation of lands valuable prospectively for the various leasable minerals. Included are all lands where the geologic data available suggest that the mineral may be present in such quantity and quality as to meet classification standards, when geologic data are not adequate for formal classification. However, this classification serves to prevent alienation of the land until formal classification is made.

b. Land, mineral and waterpower resource reports. These reports are, in effect, informal classifications of the land. They provide the land administering agencies involved in retention, exchange, multiple use or disposal activities a determination of the mineral classification of the particular lands affected.

2. Formal Classification

a. Preparation of minutes of the Mineral Land Classification Board classifying the land for the various leasable minerals and for geothermal resources.

b. Preparation of land classification plats.

c. Preparation of mineral land classification orders with recommendations to the Bureau of Land Management for restoration of the lands involved and publishing in the Federal Register.

Mineral Land Evaluation

The evaluation functions of the Conservation Division stem from the Mineral Leasing Act of 1920 and subsequent acts. These have been discussed under "Hisotry of Mineral Land Custom and Legislation" and are listed in the appendix. In general, these activities include investigations made before the land is leased.

The purpose of mineral land evaluation is to obtain geologic data necessary for planning and estimating economic mineral reserves for leasing of the Federal mineral estate. This work includes:

1. Determination of which lands should be subject to competitive leasing for each mineral and which lands should come under the prospecting permit provisions of the mineral leasing acts.

2. Delineate and publish in the Federal Register areas that contain deposits of leasable minerals subject only to competitive leasing.

3. Provide scientific and technical advice and information to the Bureau of Land Management and other land-managing agencies including the selection of tracts to be offered for lease sales and their evaluation for purposes of obtaining a fair market value return.

Areas subject only to leasing should contain deposits capable of being developed and exploited under today's economic conditions and by the technology of today's mining, oil and gas, and geothermal resources industries. Hence, in setting up evaluation standards for known leasing areas the limiting factors should include not only existence based on the intrinsic factors of thickness, quality, depth below ground surface, and extent, but also workability based on the extrinsic factors of access, distance to market, mining conditions, and other economic considerations.

Evaluation actions include:

1. Definition of known leasing areas including Known Geologic Structures of producing oil and gas fields and Known Geothermal Resource Areas. Minutes of the mineral Land Evaluation Committee are prepared, reviewed and approved, a known leasing area plat is drawn with one copy to the Bureau of Land Management and a land description published in the Federal Register.

2. Pre-lease evaluation of lands in order to advise and lend technical assistance to the Bureau of Land Management in selecting tracts for competitive lease sales, and determining a fair market value of the resources present.

3. Identification of tracts of unleased Federal lands subject to drainage by operating oil, gas, or geothermal wells.

4. Determination of mineral reserves in known leasing areas and in other areas subject to lease.

5. Geologic review of applications to lease, explore and develop Federal mineral lands including prospecting permits, non-competitive oil and gas leases, and competitive leases.

6. Environmental analysis and review of tracts eligible for lease.

7. Reports on possible surface interference from operations involving two or more commodities.

Lease Management Support

The geologic support activities to lease management also stem from the leasing acts and include all geologic work in connection with the administration of existing leases and permits. The purpose of these activities is to assure that the United States obtains fair payment for the minerals produced under lease and that no natural resources are wasted by inefficient operations.

Geologic activities related to lease management include:

1. Special purpose lease mapping.

2. Reservoir studies and mine studies.

3. Leasehold reserve studies and computations.

4. Determinations of oil and gas production rates.

5. Determinations of productive limits of oil and gas fields as of August 8, 1946.

6. Determination of Federal leases in danger of drainage by oil and gas or geothermal operations.

7. Review of:

   a. Lease development plans in Federal permits and leases.

   b. Notices of intention to drill, deepen, or plug back wells for oil and gas or geothermal resources.

   c. Development contracts.

   d. Unit plans and participating areas.

   e. Requests for abandonment of wells or mines.

Because there has been confusion in the distinctions and similarities between mineral land classification and mineral land evaluation, a summary is presented in the appendix.

MINERAL LEASING ON PUBLIC LANDS

Authority

Public Domain. The act of February 25, 1920 (41 Stat. 437; 30 U.S.C., 181 et seq.), as amended and supplemented, including the amendatory act of August 8, 1946 (60 Stat. 950; 30 U.S.C., sec. 181 et seq.) and the act of September 2, 1960 (74 Stat. 781; 30 U.S.C., sec. 181 et seq.).

Acquired lands. The Mineral Leasing Act for Acquired Lands, enacted on August 7, 1947 (61 Stat. 913; 30 U.S.C. 351-359). The authority conferred upon the Secretary by the act supersedes the authority conferred upon him by section 402 of Reorganization Plan No. 3, effective July 16, 1946 (3 CFR 1946 Supp., chapter IV) except as to leases or permits outstanding on August 7, 1947.

Special Acts. Rights-of-way. The act of May 21, 1930 (46 Stat. 373; 30 U.S.C. 301-306), authorizes the Secretary of the Interior to lease deposits of oil and gas in and under railroad and other rights-of-way acquired under any law of the United States. The right of lease is restricted to the owner of the right-of-way, or his assignees.

Definitions

Leasable minerals. Oil and gas. Gas, any fluid, either combustible or noncombustible, which is produced in a natural state from the earth and which maintains a gaseous or rarefied state at ordinary temperature and pressure conditions.

Oil, crude oil, any liquid hydrocarbon substance which occurs naturally in the earth, including drip gasoline or other natural condensates recovered from gas, without resort to manufacturing process.

Other leasable. Coal, chlorides, sulphates, carbonates, borates, silicates, or nitrates of potassium and sodium; sulphur in the States of Louisiana and New Mexico; phosphate; and native asphalt, solid and semisolid bitumen and bituminous rock (including oil impregnated rock or sands from which oil is recoverable only by special treatment after the deposit is mined or quarried).

Solid (hardrock) minerals; minerals in acquired lands which would be subject to location under the U.S. mining laws if located in the public domain lands.

Public domain lands. Original public domain lands which have never left Federal ownership; also, lands in Federal ownership which were obtained by the Government in exchange for public lands or for timber on such lands; also original public domain lands which have reverted to Federal ownership through operation of the public land laws.

Acquired lands. Lands which the United States obtains by deed through purchase or gift, or through condemnation proceedings. They are distinguish from public domain lands in that acquired may or may not have been originall owned by the Government. If originally owned by the Government such lands have been disposed of (patented) under the public land laws and thereafter reacquired by the United States.

Other lands - Withdrawn lands. Lands which have been withdrawn and dedicated to public purposes.

Segregated lands. Lands included in a withdrawal or in an application or entry which segregates them from operation of the public land laws.

Oil and gas exploration means any activity relating to the search for evidence of oil and gas which requires physical presence upon the land and which may result in damage to public lands or resources thereon. It includes, but is not limited to, geophysical operations, construction of roads and trails, and cross-country transit by vehicle over public domain. It does not include the casual use of public lands for oil and gas exploration. It does not include core drilling for subsurface geologic information or drilling for oil and gas; these activities will only be authorized by the issuance of an oil and gas lease. The regulations in this subpart, however, are not intended to prevent drilling operations necessary for placing explosive charges for seismic exploration, nor do they affect the exclusive right to "drill" for oil and gas by a lessee upon his leased premises.

Public lands means lands owned by the United States and administered by the Bureau of Land Management. It does not include retained mineral interest in lands, title to which has passed from the United States.

Noncompetitive Oil and Gas Lease. If the lands to be leased are not within a known geological structure of a producing oil or gas field, the person first making application for the lease who is qualified to hold a lease shall be entitled to a lease of such lands without competitive bidding. They are issued for a period of 10 years at a yearly rental rate of 50¢ per acre or fraction thereof.

Competitive Oil and Gas Lease. If the lands to be leased are within any known geological structure of a producing oil or gas field, they shall be leased to the highest responsible qualified bidder by competitive bidding. All bidding is by sealed bids. These leases are issued for a period of 5 years at a yearly rental rate of $2.00 per acre or fraction thereof.

Simultaneous Oil and Gas Filings (two types).

(1) Where applications or offers received by mail or filed over the counter at the same time are in conflict, the right of priority of filing has to be determined by a public drawing.

(2) The monthly simultaneous list describes lands in leases which were cancelled, relinquished, terminated or have expired. Before they are subject to leasing again, these lands must go on a list that is posted on the bulletin board in the State Office on the third Monday of each month, or the first working day thereafter if the office is not officially open on the third Monday, together with a notice that such lands will become subject to the simultaneous filings of lease offers from the time of posting until 10 a.m. on the fifth working day thereafter. The posted list will describe the lands by leasing units identified by parcel number. Filings must be on the "Simultaneous Oil and Gas Entry Card". There must be a separate entry card for each parcel. A drawing is then held to determine the successful drawee.

Open Oil and Gas Filings. These are offers which are filed for lands on which there have never been any previous oil and gas leases or for parcels which were on the simultaneous list, but no offers were received for them.

Future Interest Leases. These are leases which are issued for minerals that the United States acquired, but title thereto will not vest in the United States until some future date.

Fractional Interest Leases. These leases are issued in instances where the United States only acquired a partial interest in the minerals. Ordinarily, these leases are not issued to anyone, who, upon such issuance, would own less than 50% of the operating rights in the tract.

Assignment of Mineral Leases. An assignment is the sale of an interest in the lease held by the record title holder thereof. The entire leasehold can be assigned or it may be assigned in part only. An assignment may also be of an undivided interest in the entire leasehold or a designated portion thereof.

Termination. A lease terminates when the lessee fails to pay the rental on or before the anniversary date of the lease.

Expiration. A lease expires when it has run its full term and there has been no production thereon.

Relinquishment. In oil and gas leases, the record title holder may relinquish a lease or any legal subdivision by filing a written relinquishment in the proper State Office. It shall take effect on the date it is filed, subject to the continued obligation of the lessee and his surety to make payments of all accrued rentals and royalties and to place all wells on the land to be relinquished, in condition for suspension or abandonment. A prospecting permittee has the same right to relinquish all or part of his permit and it will be effective on the date it is filed, subject to the continued obligation of the permittee and his surety to make payment of all accrued rentals and royalties, and to provide for the preservation of any mines or productive works or permanent improvements on the permit lands. Upon a satisfactory showing that the public interest

will not be impaired, the mining lessee may surrender the entire lease or any legal subdivision thereof. Upon its acceptance, it shall be effective as of the date filed, subject to continued obligation of the lessee and his surety to make payment of all accrued rentals and royalties and to provide for the preservation of any mines or productive works or permanent improvements on the leased lands in accordance with the regulations and terms of the lease.

Prospecting Permit. The Secretary of the Interior is authorized to issue permits to qualified applicants to prospect unclaimed and undeveloped areas of mineral lands and mineral deposits in public and acquired lands or in public and acquired lands disposed of with a reservation to the United States. These permits are issued for a two-year period at the yearly rental rate of 25¢ per acre or fraction thereof, but no less than $20.00 per year. Prospecting permits may be extended for a period of two years, with the exception of sodium and sulphur (no extension of term will be granted for these two minerals) and phosphate permits may be extended for a period of four years. No prospecting permits are issued for oil and gas, geothermal or coal or on lands under claim.

Preference Right Lease. A permittee who discovers valuable mineral deposits in the land before his permit expires is entitled to a preference right lease of all or part of the lands in the permit in a reasonably compact form. Exception - coal. ~~Showing is required that the land in his application contains coal in commercial quantities.~~ [see amendment CFR.43

Coal License. Coal licenses may be issued for a period of 2 years to individuals and associations of individuals to mine and take coal for their own local domestic need for fuel, but in no case for barter or sale, without the payment of any rent or royalty. Licenses may be issued to municipalities to mine and dispose of coal without profit to their residents for household use. Under such a license, the municipality may not mine coal either for its own use or for nonhousehold use such as for factories, stores, other business establishments and heating and lighting plants.

Drilling Permit. It is as its name implies, a permit issued by Geological Survey, allowing an oil and gas lessee to go out and drill a development well or exploratory well.

Exploratory Well. A well drilled two miles or more from an existing Known Geological Structure (KGS), or if not established, two miles or more from an existing producible well. Inspection of site is required by both Geological Survey and the surface management agency. An environmental analysis will be made by Geological Survey, in consultation with the appropriate management agency, for the purpose of insuring proper protection of the natural resources, the environment, existing improvements and for assuring timely reclamation of disturbed lands.

Development Well. A well drilled near a producing field to a known producing formation. The intent is to expand the boundaries of the oil or gas field. These can be dry holes if they are outside of the field. Ground inspection is optional, but will be done if the surface management agency requests it.

Known Geological Structure. Boundaries of Known Geological Structures are determined by the Director of the U. S. Geological Survey. They are determined on a defined and undefined basis. Through the years G.S. has defined the Known Geological Structure of a producing oil or gas field as the trap, whether structural or stratigraphic, in which the accumulation of oil or gas has taken place. The limits of such structure include all acreage that is presumptively productive.

Undefined Known Geological Structures are of 2 types, namely:

(1) An area where discovery necessitates the defining of a new productive area, and revisions thereof.

(2) An area where development around a previously defined structure warrants an extension of the established Known Geological Structure.

Known Leasing Area. The Director, Geological Survey, establishes the known leasing areas. A KLA is an area known to contain valuable deposits of leasable minerals. Technically a KLA is that area in which there is direct geologic evidence that the mineral deposit is known or believed to exist in sufficient quantity and of such quality to establish that the deposit is workable and that prospecting is not required to determine these factors.

MINERAL LAW CLASSIFICATION OF MINERALS

Leaseable Minerals - Defined by Laws

(a) Oil and Gas
(b) Sodium
(c) Potassium
(d) Phosphate
(e) Coal
(f) Oil Shale
(g) Asphaltic Materials
(h) Sulfur in Louisiana and Parts of New Mexico
(i) Geothermal steam and associated geothermal resources

Locatable Minerals - (must meet prudent means rule and marketabilities test for uncommon minerals)

(a) Minerals of marketable value: Pb, Zn, Cu, Au, Ag, bentonite, zeolites
(b) Widespread - Common Place - Non-metallic type minerals: Perlite, Metallurgical grade limestone - Silica, Diatomite, Glass sand, Foundary sand, etc.

Saleable Minerals - Defined by decisions, PL 167 and Materials Sale Act

(a) Common varieties of:
1. Sand)
2. Stone)
3. Gravel)
4. Pumice) PL 167 & Mat. Sale Act
5. Pumicite)
6. Cinders)
7. Petrified Wood)

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8. Common Clay)
9. Fill Material)
10. Aolean Sand)

SIXTY-SIXTH CONGRESS. Sess. II. Chs. 83-85. 1920

1920 Mineral Leasing Act -- (see amendments) for potassium, asphalt, etc.

CHAP. 85 -- An Act To promote the mining of coal, phosphate, oil, oil shale, gas, and sodium on the public domain.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, that deposits of coal, phosphate, sodium, oil, oil shale, of gas, and lands containing such deposits owned by the United Staets, including those in national forests, but excluding lands acquired under the Act known as the Appa-

(continued on next page)

lachian Forest Act, approved March 1, 1911 (Thirty-sixth Statutes, page 961), and those in national parks, and in lands withdrawn or reserved for military or naval uses or purposes, except as hereinafter provided, shall be subject to disposition in the form and manner provided by this Act to citizens of the United States, or to any association of such persons, or to any corporation organized under the laws of the United States, or of any State or Territory thereof, and in the case of coal, oil, oil shale, or gas, to municipalities: *Provided*, That the United States reserves the right to extract helium from all gas produced from lands permitted, leased, or otherwise granted under the provisions of this Act, under such rules and regulations as shall be prescribed by the Secretary of the Interior: *Provided further*, That in the extraction of helium from gas produced from such lands, it shall be so extracted as to cause no substantial delay in the delivery of gas produced from the well to the purchaser thereof: *And provided further*, That citizens of another country, the laws, customs, or regulations of which, deny similar or like privileges to citizens or corporations of this country, shall not by stock ownership, stock holding, or stock control, own any interest in any lease acquired under the provisions of this Act.

Coal, etc., to municipalities.

Provisos.
Helium production reserved.

Not to delay gas delivery.

Foreign interests restricted.

Coal lands.

COAL.

Division of, into leasing tracts.

SEC. 2. That the Secretary of the Interior is authorized to, and upon the petition of any qualified applicant shall, divide any of the coal lands or the deposits of coal, classified and unclassified, owned by the United States, outside of the Territory of Alaska, into leasing tracts of forty acres each, or multiples thereof, and in such form as, in the opinion of the Secretary of the Interior, will permit the most economical mining of the coal in such tracts, but in no case exceeding two thousand five hundred and sixty acres in any one leasing tract, and thereafter the Secretary of the Interior shall, in his discretion, upon the request of any qualified applicant or on his own motion, from time to time, offer such lands or deposits of coal for leasing, and shall award leases thereon by competitive bidding or by such other methods as he may by general regulations adopt, to any qualified applicant: *Provided*, That the Secretary is hereby authorized, in awarding leases for coal lands heretofore improved and occupied or claimed in good faith, to consider and recognize equitable rights of such occupants or claimants: *Provided further*, That where prospecting or exploratory work is necessary to determine the existence or workability of coal deposits in any unclaimed, undeveloped area, the Secretary of the Interior may issue, to applicants qualified under this Act, prospecting permits for a term of two years, for not exceeding two thousand five hundred and sixty acres; and if within said period of two years thereafter, the permittee shows to the Secretary that the land contains coal in commercial quantities, the permittee shall be entitled to a lease under this Act for all or part of the land in his permit: *And provided further*, That no lease of coal under this Act shall be approved or issued until after notice of the proposed lease, or offering for lease, has been given for thirty days in a newspaper of general circulation in the county in which the lands or deposits are situated: *And provided further*, That no company or corporation operating a common carrier railroad shall be given or hold a permit or lease under the provisions of this Act for any coal deposits except for its own use for railroad purposes; and [illegible] in all permits and leases issued to such companies or corporations, and no such company or corporation shall receive or hold more than one permit or lease for each two hundred miles of its railroad line within the State in which said property is situated, exclusive of

Alaska excluded.
Vol. 38, p. 741.

Offer to qualified applicants for leasing.

Provisos.
Rights of present claimants.

Prospecting permits for undeveloped lands.

Lease on discovery.

Public notice to be given.

Limitation on leases to railroads.

spurs or switches and exclusive of branch lines built to connect the leased coal with the railroad, and also exclusive of parts of the railroad operated mainly by power produced otherwise than by steam: *And provided further*, That nothing herein shall preclude such a railroad of less than two hundred miles in length from securing and holding one permit or lease hereunder.

Short line roads.

SEC. 3. That any person, association, or corporation holding a lease of coal lands or coal deposits under this Act may, with the approval of the Secretary of the Interior, upon a finding by him that it will be for the advantage of the lessee and the United States, secure modifications of his or its original lease by including additional coal lands or coal deposits contiguous to those embraced in such lease, but in no event shall the total area embraced in such modified lease exceed in the aggregate two thousand five hundred and sixty acres.

Additional contiguous lands allowed lessees.

Limit.

SEC. 4. That upon satisfactory showing by any lessee to the Secretary of the Interior that all of the workable deposits of coal within a tract covered by his or its lease will be exhausted, worked out, or removed within three years thereafter, the Secretary of the Interior may, within his discretion, lease to such lessee an additional tract of land or coal deposits, which, including the coal area remaining in the existing lease, shall not exceed two thousand five hundred and sixty acres, through the same procedure and under the same conditions as in case of an original lease.

Additional tracts on exhaustion of deposits.

Limit, etc.

SEC. 5. That if, in the judgment of the Secretary of the Interior, the public interest will be subserved thereby, lessees holding under lease areas not exceeding the maximum permitted under this Act may consolidate their leases through the surrender of the original leases and the inclusion of such areas in a new lease of not to exceed two thousand five hundred and sixty acres of contiguous lands.

Consolidation permitted leaseholders.

SEC. 6. That where coal or phosphate lands aggregating two thousand five hundred and sixty acres and subject to lease hereunder do not exist as contiguous areas, the Secretary of the Interior is authorized, if, in his opinion the interests of the public and of the lessee will be thereby subserved, to embrace in a single lease noncontiguous tracts which can be operated as a single mine or unit.

Operation of noncontiguous coal or phosphate tracts.

SEC. 7. That for the privilege of mining or extracting the coal in the lands covered by the lease the lessee shall pay to the United States such royalties as may be specified in the lease, which shall be fixed in advance of offering the same, and which shall not be less than 5 cents per ton of two thousand pounds, due and payable at the end of each third month succeeding that of the extraction of the coal from the mine, and an annual rental, payable at the date of such lease and annually thereafter, on the lands or coal deposits covered by such lease, at such rate as may be fixed by the Secretary of the Interior prior to offering the same, which shall not be less than 25 cents per acre for the first year thereafter, not less than 50 cents per acre for the second, third, fourth, and fifth years, respectively, and not less than $1 per acre for each and every year thereafter during the continuance of the lease, except that such rental for any year shall be credited against the royalties as they accrue for that year. Leases shall be for indeterminate periods upon condition of diligent development and continued operation of the mine or mines, except when such operation shall be interrupted by strikes, the elements, or casualties not attributable to the lessee, and upon the further condition that at the end of each twenty-year period succeeding the date of the lease such reading [illegible] Secretary of the Interior may determine, unless otherwise provided by law at the time of the expiration of such periods: *Provided*, That the Secretary of the Interior may, if in his judgment the public inter-

Royalties payable to be specified in lease.

Annual rental.

Credited against royalties.

Period indeterminate.

Conditions.

Readjustment of [illegible]

Provisos.

Annual advance payment in lieu of continuous operation.

est will be subserved thereby, in lieu of the provision herein contained requiring continuous operation of the mine or mines, provide in the lease for the payment of an annual advance royalty upon a minimum number of tons of coal, which in no case shall aggregate less than the amount of rentals herein provided for: *Provided further*, That the Secretary of the Interior may permit suspension of operation under such lease for not to exceed six months at any one time when market conditions are such that the lease can not be operated except at a loss.

Suspension of operations, to avert loss.

Limited licenses for mining for domestic uses, without royalty.

SEC. 8. That in order to provide for the supply of strictly local domestic needs for fuel, the Secretary of the Interior may, under such rules and regulations as he may prescribe in advance, issue limited licenses or permits to individuals or associations of individuals to prospect for, mine, and take for their use but not for sale, coal from the public lands without payment of royalty for the coal mined or the land occupied, on such conditions not inconsistent with this Act as in his opinion will safeguard the public interests: *Provided*, That this privilege shall not extend to any corporations: *Provided further*, That in the case of municipal corporations the Secretary of the Interior may issue such limited license or permit, for not to exceed three hundred and twenty acres for a municipality of less than one hundred thousand population, and not to exceed one thousand two hundred and eighty acres for a municipality of not less than one hundred thousand and not more than one hundred and fifty thousand population; and not to exceed two thousand five hundred and sixty acres for a municipality of one hundred and fifty thousand population or more, the land to be selected within the State wherein the municipal applicant may be located, upon condition that such municipal corporations will mine the coal therein under proper conditions and dispose of the same without profit to residents of such municipality for household use: *And provided further*, That the acquisition or holding of a lease under the preceding sections of this Act shall be no bar to the holding of such tract or operation of such mine under said limited license.

Provisos.
Corporations excluded.

Areas to municipalities for household use without profit.

Allowed holders of other leases.

PHOSPHATES.

Phosphate deposits.

Leases authorized of lands containing.

SEC. 9. That the Secretary of the Interior is hereby authorized to lease to any applicant qualified under this Act any lands belonging to the United States containing deposits of phosphates, under such restrictions and upon such terms as are herein specified, through advertisement, competitive bidding, or such other methods as the Secretary of the Interior may by general regulation adopt.

Extent of area.

SEC. 10. That each lease shall be for not to exceed two thousand five hundred and sixty acres of land to be described by the legal subdivisions of the public land surveys, if surveyed; if unsurveyed, to be surveyed by the Government at the expense of the applicant for lease, in accordance with rules and regulations prescribed by the Secretary of the Interior and the lands leased shall be conformed to and taken in accordance with the legal subdivisions of such survey; deposits made to cover expense of surveys shall be deemed appropriated for that purpose; and any excess deposits shall be repaid to the person, association, or corporation making such deposits or their legal representatives: *Provided*, That the land embraced in any one lease shall be in compact form, the length of which shall not exceed two and one half times its width.

Payment for surveys.

Proviso.
Form of holding.

Royalties to be specified in the lease.

SEC. 11. That for the privilege of mining or extracting the phosphates or phosphate rock covered by the lease the lessee shall pay to the United States such royalties as may be specified in the lease, [illegible] offering the same, which shall be not less than 2 per centum of the gross value of the output of phosphates or phosphate rock at the mine, due and payable at the end of each third month succeeding that of

Amount on output.

the sale or other disposition of the phosphates or phosphate rock, and an annual rental payable at the date of such lease and annually thereafter on the area covered by such lease at such rate as may be fixed by the Secretary of the Interior prior to offering the lease, which shall be not less than 25 cents per acre for the first year thereafter, 50 cents per acre for the second, third, fourth, and fifth years, respectively, and $1 per acre for each and every year thereafter during the continuance of the lease, except that such rental for any year shall be credited against the royalties as they accrue for that year. Leases shall be for indeterminate periods upon condition of a minimum annual production, except when operation shall be interrupted by strikes, the elements, or casualties not attributable to the lessee, and upon the further condition that at the end of each twenty-year period succeeding the date of the lease such readjustment of terms and conditions shall be made as the Secretary of the Interior shall determine unless otherwise provided by law at the time of the expiration of such periods: *Provided*, That the Secretary of the Interior may permit suspension of operation under such lease for not exceeding twelve months at any one time when market conditions are such that the lease can not be operated except at a loss.

Annual rental.

Rental credited against royalties.

Period indeterminate.

Conditions.

Proviso.
Temporary suspension of operations to avert loss.

SEC. 12. That any qualified applicant to whom the Secretary of the Interior may grant a lease to develop and extract phosphates, or phosphate rock, under the provisions of this Act shall have the right to use so much of the surface of unappropriated and unentered lands, not exceeding forty acres, as may be determined by the Secretary of the Interior to be necessary for the proper prospecting for or development, extraction, treatment, and removal of such mineral deposits.

Surface lands for development works, etc., allowed.

OIL AND GAS.

Oil and gas deposits.

SEC. 13. That the Secretary of the Interior is hereby authorized, under such necessary and proper rules and regulations as he may prescribe, to grant to any applicant qualified under this Act a prospecting permit, which shall give the exclusive right, for a period not exceeding two years, to prospect for oil or gas upon not to exceed two thousand five hundred and sixty acres of land wherein such deposits belong to the United States and are not within any known geological structure of a producing oil or gas field upon condition that the permittee shall begin drilling operations within six months from the date of the permit, and shall, within one year from and after the date of permit, drill one or more wells for oil or gas to a depth of not less than five hundred feet each, unless valuable deposits of oil or gas shall be sooner discovered, and shall, within two years from date of the permit, drill for oil or gas to an aggregate depth of not less than two thousand feet unless valuable deposits of oil or gas shall be sooner discovered. The Secretary of the Interior may, if he shall find that the permittee has been unable with the exercise of diligence to test the land in the time granted by the permit, extend any such permit for such time, not exceeding two years, and upon such conditions as he shall prescribe. Whether the lands sought in any such application and permit are surveyed or unsurveyed the applicant shall, prior to filing his application for permit, locate such lands in a reasonably compact form and according to the legal subdivisions of the public land surveys if the land be surveyed; and in an approximately square or rectangular tract if the land be an unsurveyed tract, the length of which shall not exceed two and one-half times its width, and if he shall cause to be erected upon the land for which [illegible] at some conspicuous place thereon, and shall post a notice in writing on or near said monument, stating that an application for permit will be made within thirty days after date of posting said notice, the

Exclusive prospecting permits for, authorized.

Not within known producing fields.

Drilling conditions.

Time extension of permits.

Location.
On surveyed lands.

Notice, etc., of application for unsurveyed lands.

name of the applicant, the date of the notice, and such a general description of the land to be covered by such permit by reference to courses and distances from such monument and such other natural objects and permanent monuments as will reasonably identify the land, stating the amount thereof in acres, he shall during the period of thirty days following such marking and posting, be entitled to a preference right over others to a permit for the land so identified. The applicant shall, within ninety days after receiving a permit, mark each of the corners of the tract described in the permit upon the ground with substantial monuments, so that the boundaries can be readily traced on the ground, and shall post in a conspicuous place upon the lands a notice that such permit has been granted and a description of the lands covered thereby: *Provided*, That in the Territory of Alaska prospecting permits not more than five in number may be granted to any qualified applicant for periods not exceeding four years, actual drilling operations shall begin within two years from date of permit, and oil and gas wells shall be drilled to a depth of not less than five hundred feet, unless valuable deposits of oil or gas shall be sooner discovered, within three years from date of the permit and to an aggregate depth of not less than two thousand feet unless valuable deposits of oil or gas shall be sooner discovered, within four years from date of permit: *Provided further*, That in said Territory the applicant shall have a preference right over others to a permit for land identified by temporary monuments and notice posted on or near the same for six months following such marking and posting, and upon receiving a permit he shall mark the corners of the tract described in the permit upon the ground with substantial monuments within one year after receiving such permit.

Issue of permit.

Corner marks, etc., on reserved tracts.

Provisos. Drilling periods, etc., in Alaska.

Preference to first locators.

SEC. 14. That upon establishing to the satisfaction of the Secretary of the Interior that valuable deposits of oil or gas have been discovered within the limits of the land embraced in any permit, the permittee shall be entitled to a lease for one-fourth of the land embraced in the prospecting permit: *Provided*, That the permittee shall be granted a lease for as much as one hundred and sixty acres of said lands, if there be that number of acres within the permit. The area to be selected by the permittee, shall be in compact form and, if surveyed, to be described by the legal subdivisions of the public-land surveys; if unsurveyed, to be surveyed by the Government at the expense of the applicant for lease in accordance with rules and regulations to be prescribed by the Secretary of the Interior and the lands leased shall be conformed to and taken in accordance with the legal subdivisions of such surveys; deposits made to cover expense of surveys shall be deemed appropriated for that purpose, and any excess deposits may be repaid to the person or persons making such deposit or their legal representatives. Such leases shall be for a term of twenty years upon a royalty of 5 per centum in amount or value of the production and the annual payment in advance of a rental of $1 per acre, the rental paid for any one year to be credited against the royalties as they accrue for that year, with the right of renewal as prescribed in section 17 hereof. The permittee shall also be entitled to a preference right to a lease for the remainder of the land in his prospecting permit at a royalty of not less than 12½ per centum in amount or value of the production, and under such other conditions as are fixed for oil or gas leases in this Act, the royalty to be determined by competitive bidding or fixed by such other method as the Secretary may [illegible] Secretary shall have the right to reject any or all bids.

Lease to permittee on discovery. Limit.

Provisos. Minimum.

Selection of surveyed land.

Unsurveyed, applicant to pay for surveying.

Term, royalty, and rentals.

Renewal. *Post*, p. 413.

Preference for remainder of prospected area.

Minimum royalty, etc.

Proviso. Bidding condition.

SEC. 15. That until the permittee shall apply for lease to the one quarter of the permit area heretofore provided for he shall pay to the United States 20 per centum of the gross value of all oil or gas

Payment for product expired before applying for lease.

secured by him from the lands embraced within his permit and sold or otherwise disposed of or held by him for sale or other disposition.

Drilling restrictions.

SEC. 16. That all permits and leases of lands containing oil or gas, made or issued under the provisions of this Act, shall be subject to the condition that no wells shall be drilled within two hundred feet of any of the outer boundaries of the lands so permitted or leased, unless the adjoining lands have been patented or the title thereto otherwise vested in private owners, and to the further condition that the permittee or lessee will, in conducting his explorations and mining operations, use all reasonable precautions to prevent waste of oil or gas developed in the land, or the entrance of water through wells drilled by him to the oil sands or oil-bearing strata, to the destruction or injury of the oil deposits. Violations of the provisions of this section shall constitute grounds for the forfeiture of the permit or lease, to be enforced through appropriate proceedings in courts of competent jurisdiction.

Prevention of waste, etc.

Forfeiture for violations.

Leases of unappropriated deposits in known producing fields.

SEC. 17. That all unappropriated deposits of oil or gas situated within the known geologic structure of a producing oil or gas field and the unentered lands containing the same, not subject to preferential lease, may be leased by the Secretary of the Interior to the highest responsible bidder by competitive bidding under general regulations to qualified applicants in areas not exceeding six hundred and forty acres and in tracts which shall not exceed in length two and one-half times their width, such leases to be conditioned upon the payment by the lessee of such bonus as may be accepted and of such royalty as may be fixed in the lease, which shall not be less than 12½ per centum in amount or value of the production, and the payment in advance of a rental of not less than $1 per acre per annum thereafter during the continuance of the lease, the rental paid for any one year to be credited against the royalties as they accrue for that year. Leases shall be for a period of twenty years, with the preferential right in the lessee to renew the same for successive periods of ten years upon such reasonable terms and conditions as may be prescribed by the Secretary of the Interior, unless otherwise provided by law at the time of the expiration of such periods. Whenever the average daily production of any oil well shall not exceed ten barrels per day, the Secretary of the Interior is authorized to reduce the royalty on future production when in his judgment the wells can not be successfully operated upon the royalty fixed in the lease. The provisions of this paragraph shall apply to all oil and gas leases made under this Act.

Competitive bidding.

Areas limited.

Payment of bonus, royalties, and rental.

Period of leases; renewals.

Reduction of royalty for small production.

Applicable to all leases.

Withdrawn oil or gas lands.

Leases, on surrender of rights, etc., by claimants under mining laws having producing wells.

SEC. 18. That upon relinquishment to the United States, filed in the General Land Office within six months after the approval of this Act, of all right, title, and interest claimed and possessed prior to July 3, 1910, and continuously since by the claimant or his predecessor in interest under the preexisting placer mining law to any oil or gas bearing land upon which there has been drilled one or more oil or gas wells to discovery embraced in the Executive order of withdrawal issued September 27, 1909, and not within any naval petroleum reserve, and upon payment as royalty to the United States of an amount equal to the value at the time of production of one-eighth of all the oil or gas already produced except oil or gas used for production purposes on the claim, or unavoidably lost, from such land, the claimant, or his successor, if in possession of such land, undisputed by any other claimant prior to July 1, 1919, shall be entitled to a lease thereon from the United States for a period of twenty years, at a royalty of not less than 12½ per centum of all the oil or gas produced except oil or gas used for [illegible] claim, or unavoidably lost: *Provided*, That not more than one-half of the area, but in no case to exceed three thousand two hundred acres, within the geologic oil or gas structure of a producing oil or gas field shall be leased to any one claimant under the provision of

Payment for oil produced.

Period of lease; royalty.

Area limited to one claimant.

Selection allowed.

this section when the area of such geologic oil structure exceeds six hundred and forty acres. Any claimant or his successor, subject to this limitation, shall, however, have the right to select and receive the lease as in this section provided for that portion of his claim or claims equal to, but not in excess of, said one-half of the area of such geologic oil structure, but not more than three thousand two hundred acres.

Regulations, etc., to be prescribed.

All such leases shall be made and the amount of royalty to be paid for oil and gas produced, except oil or gas used for production purposes on the claim, or unavoidably lost, after the execution of such lease shall be fixed by the Secretary of the Interior under appropriate rules and regulations: *Provided, however,* That as to all like claims situate within any naval petroleum reserve the producing wells thereon only shall be leased, together with an area of land sufficient for the operation thereof, upon the terms and payment of royalties for past and future production as herein provided for in the leasing of claims. No wells shall be drilled in the land subject to this provision within six hundred and sixty feet of any such leased well without the consent of the lessee: *Provided, however,* That the President may, in his discretion, lease the remainder or any part of any such claim upon which such wells have been drilled, and in the event of such leasing said claimant or his successor shall have a preference right to such lease: *And provided further,* That he may permit the drilling of additional wells by the claimant or his successor within the limited area of six hundred and sixty feet theretofore provided for upon such terms and conditions as he may prescribe.

Provisos.
Naval petroleum reserve leasing restrictions.

Lease of remainder of claim.

Additional drilling permitted.

Benefits barred by fraud.

No claimant for a lease who has been guilty of any fraud or who had knowledge or reasonable grounds to know of any fraud, or who has not acted honestly and in good faith, shall be entitled to any of the benefits of this section.

Settlement of pending oil land suits on acceptance of leases.

Vol. 38, p. 708.
Vol. 36, p. 1015.

Upon the delivery and acceptance of the lease, as in this section provided, all suits brought by the Government affecting such lands may be settled and adjusted in accordance herewith and all moneys impounded in such suits or under the Act entitled "An Act to amend an Act entitled 'An Act to protect the locators in good faith of oil and gas lands who shall have effected an actual discovery of oil or gas on the public lands of the United States, or their successors in interest,' approved March 2, 1911," approved August 25, 1914 (Thirty-eighth Statutes at Large, page 708), shall be paid over to the parties entitled thereto. In case of conflicting claimants for leases under this section, the Secretary of the Interior is authorized to grant leases to one or more of them as shall be deemed just. All leases hereunder shall inure to the benefit of the claimant and all persons claiming through or under him by lease, contract, or otherwise, as their interests may appear, subject, however, to the same limitation as to area and acreage as is provided for claimant in this section: *Provided,* That no claimant acquiring any interest in such lands since September 1, 1919, from a claimant on or since said date claiming or holding more than the maximum allowed claimant under this section shall secure a lease thereon or any interest therein, but the inhibition of this proviso shall not apply to an exchange of any interest in such lands made prior to the 1st day of January, 1920, which did not increase or reduce the area or acreage held or claimed in excess of said maximum by either party to the exchange: *Provided further,* That no lease [illegible] under this section shall be granted, nor shall any interest therein, inure to any person, association, or corporation for a greater aggregate area or acreage than the maximum in this section provided for.

Impounded moneys to be paid.
Conflicting claimants.
Effect of leases.

Provisos.
Restriction on interests acquired from claimants holding more than maximum area.

Exception.

Area restricted.

Compromise of existing placer claims.

SEC. 18a. That whenever the validity of any gas or petroleum placer claim under preexisting law to land embraced in the Executive

order of withdrawal issued September 27, 1909, has been or may hereafter be drawn in question on behalf of the United States in any departmental or judicial proceedings, the President is hereby authorized at any time within twelve months after the approval of this Act to direct the compromise and settlement of any such controversy upon such terms and conditions as may be agreed upon, to be carried out by an exchange or division of land or division of the proceeds of operation.

Terms and conditions.

Oil or gas lands not withdrawn.

Prospecting permits to valid claimants not making discovery.

SEC. 19. That any person who on October 1, 1919, was a bona fide occupant or claimant of oil or gas lands under a claim initiated while such lands were not withdrawn from oil or gas location and entry, and who had previously performed all acts under then existing laws necessary to valid locations thereof except to make discovery, and upon which discovery had not been made prior to the passage of this Act, and who has performed work or expended on or for the benefit of such locations an amount equal in the aggregate of $250 for each location if application therefor shall be made within six months from the passage of this Act shall be entitled to prospecting permits thereon upon the same terms and conditions, and limitations as to acreage, as other permits provided for in this Act, or where any such person has heretofore made such discovery, he shall be entitled to a lease thereon under such terms as the Secretary of the Interior may prescribe unless otherwise provided for in section 18 hereof: *Provided*, That where such prospecting permit is granted upon land within any known geologic structure of a producing oil or gas field, the royalty to be fixed in any lease thereafter granted thereon or any portion thereof shall be not less than 12½ per centum of all the oil or gas produced except oil or gas used for production purposes on the claim, or unavoidably lost: *Provided, however*, That the provisions of this section shall not apply to lands reserved for the use of the Navy: *Provided, however*, That no claimant for a permit or lease who has been guilty of any fraud or who had knowledge or reasonable grounds to know of any fraud, or who has not acted honestly and in good faith, shall be entitled to any of the benefits of this section.

Prior work required.

Lease if discovery made.

Proviso.
Royalty, if in producing fields.

Naval lands excluded.

Benefits barred by fraud.

All permits or leases hereunder shall inure to the benefit of the claimant and all persons claiming through or under him by lease, contract, or otherwise, as their interests may appear.

Persons entitled to permits.

Agricultural entrymen on reserved lands.
Preference right to, for permit and lease, on discovery.

SEC. 20. In the case of lands bona fide entered as agricultural, and not withdrawn or classified as mineral at the time of entry, but not including lands claimed under any railroad grant, the entryman or patentee, or assigns, where assignment was made prior to January 1, 1918, if the entry has been patented with the mineral right reserved, shall be entitled to a preference right to a permit and to a lease, as herein provided, in case of discovery; and within an area not greater than a township such entryman and patentees, or assigns holding restricted patents may combine their holdings, not to exceed two thousand five hundred and sixty acres for the purpose of making joint application. Leases executed under this section and embracing only lands so entered shall provide for the payment of a royalty of not less than 12½ per centum as to such areas within the permit as may not be included within the discovery lease to which the permittee is entitled under section 14 hereof.

Combinations permitted.

Royalties.

Ante, p. 442.

OIL SHALE.

Oil shale deposits.

Leases authorized of lands containing.

SEC. 21. That the Secretary of the Interior is hereby authorized to lease to any person or corporation qualified under this Act any deposits of oil shale belonging to the United States and the surface of so much of the public lands containing such deposits, or land adjacent thereto, as may be required for the extraction and reduction of the leased minerals, under such rules and regulations, not inconsistent with this

Area limited.

Act, as he may prescribe; that no lease hereunder shall exceed five thousand one hundred and twenty acres of land, to be described by the legal subdivisions of the public-land surveys, or if unsurveyed, to be surveyed by the United States, at the expense of the applicant, in accordance with regulations to be prescribed by the Secretary of the Interior. Leases may be for indeterminate periods, upon such conditions as may be imposed by the Secretary of the Interior, including covenants relative to methods of mining, prevention of waste, and productive development. For the privilege of mining, extracting, and disposing of the oil or other minerals covered by a lease under this section the lessee shall pay to the United States such royalties as shall be specified in the lease and an annual rental, payable at the beginning of each year, at the rate of 50 cents per acre per annum, for the lands included in the lease, the rental paid for any one year to be credited against the royalties accruing for that year; such royalties to be subject to readjustment at the end of each twenty-year period by the Secretary of the Interior: *Provided*, That for the purpose of encouraging the production of petroleum products from shales the Secretary may, in his discretion, waive the payment of any royalty and rental during the first five years of any lease: *Provided*, That any person having a valid claim to such minerals under existing laws on January 1, 1919, shall, upon the relinquishment of such claim, be entitled to a lease under the provisions of this section for such area of the land relinquished as shall not exceed the maximum area authorized by this section to be leased to an individual or corporation: *Provided, however*, That no claimant for a lease who has been guilty of any fraud or who had knowledge or reasonable grounds to know of any fraud, or who has not acted honestly and in good faith, shall be entitled to any of the benefits of this section: *Provided further*, That not more than one lease shall be granted under this section to any one person, association, or corporation.

Period and conditions of leases.

Royalties and rentals.

Provisos.
Discretionary waiving of royalties.

Leases to claimants relinquishing former rights.

Benefits barred by fraud.

Only one lease to any person, etc.

ALASKA OIL PROVISO.

Alaska oil deposits.

SEC. 22. That any bona fide occupant or claimant of oil or gas bearing lands in the Territory of Alaska, who, or whose predecessors in interest, prior to withdrawal had complied otherwise with the requirements of the mining laws, but had made no discovery of oil or gas in wells and who prior to withdrawal had made substantial improvements for the discovery of oil or gas on or for each location or had prior to the passage of this Act expended not less than $250 in improvements on or for each location shall be entitled, upon relinquishment or surrender to the United States within one year from the date of this Act, or within six months after final denial or withdrawal of application for patent, to a prospecting permit or permits, lease or leases, under this Act covering such lands, not exceeding five permits or leases in number and not exceeding an aggregate of one thousand two hundred and eighty acres in each: *Provided*, That leases in Alaska under this Act whether as a result of prospecting permits or otherwise shall be upon such rental and royalties as shall be fixed by the Secretary of the Interior and specified in the lease, and be subject to readjustment at the end of each twenty-year period of the lease: *Provided further*, That for the purpose of encouraging the production of petroleum products in Alaska the Secretary may, in his discretion, waive the payment of any rental or royalty not exceeding the first five years of any lease.

Prospecting permits to valid mining claimants not discovering oil or gas.

Former application to be relinquished.

Number of permits allowed.

Provisos.
Royalties, rentals, etc.

Discretionary waiving of royalties.

No claimant for a lease who has been guilty of any fraud or who had knowledge or reasonable grounds to know of any fraud, or who has not acted honestly and in good faith, shall be entitled to any of the benefits of this section.

Benefits barred by fraud.

SODIUM.

Sodium deposits.

SEC. 23. That the Secretary of the Interior is hereby authorized and directed, under such rules and regulations as he may prescribe, to grant to any qualified applicant a prospecting permit which shall give the exclusive right to prospect for chlorides, sulphates, carbonates, borates, silicates, or nitrates of sodium dissolved in and soluble in water, and accumulated by concentration, in lands belonging to the United States for a period of not exceeding two years: *Provided*, That the area to be included in such a permit shall be not exceeding two thousand five hundred and sixty acres of land in reasonably compact form: *Provided further*, That the provisions of this section shall not apply to lands in San Bernardino County, California.

Prospecting permits allowed for.

Proviso. Area limited.

Lands excluded.

SEC. 24. That upon showing to the satisfaction of the Secretary of the Interior that valuable deposits of one of the substances enumerated in section 23 hereof has been discovered by the permittee within the area covered by his permit and that such land is chiefly valuable therefor the permittee shall be entitled to a lease for one-half of the land embraced in the prospecting permit, at a royalty of not less than one-eighth of the amount or value of the production, to be taken and described by legal subdivisions of the public-land surveys, or if the land be not surveyed by survey executed at the cost of the permittee in accordance with the rules and regulations to be prescribed by the Secretary of the Interior. The permittee shall also have the preference right to lease the remainder of the lands embraced within the limits of his permit at a royalty of not less than one-eighth of the amount or value of the production to be fixed by the Secretary of the Interior. Lands known to contain such valuable deposits as are enumerated in section 23 hereof and not covered by permits or leases, except such lands as are situated in said county of San Bernardino, shall be held subject to lease, and may be leased by the Secretary of the Interior through advertisement, competitive bidding, or such other methods as he may by general regulations adopt, and in such areas as he shall fix, not exceeding two thousand five hundred and sixty acres: all leases to be conditioned upon the payment by the lessee of such royalty of not less than one-eighth of the amount or value of the production as may be fixed in the lease, and the payment in advance of a rental of 50 cents per acre for the first calendar year or fraction thereof and $1 per acre per annum thereafter during the continuance of the lease, the rental paid for any one year to be credited on the royalty for that year. Leases may be for indeterminate periods, subject to readjustment at the end of each twenty-year period, upon such conditions not inconsistent herewith as may be incorporated in each lease or prescribed in general regulation theretofore issued by the Secretary of the Interior, including covenants relative to mining methods, waste, period of preliminary development, and minimum production, and a lessee under this section may be lessee of the remaining lands in his permit.

Lease to permittee of one-half of area in which discovery made.

Royalty.

Preference to lease remainder of land.

Land containing known deposits subject to lease. Conditions.

Royalties, rentals, etc.

Periods and conditions of leases.

SEC. 25. That in addition to areas of such mineral land which may be included in any such prospecting permits or leases, the Secretary of the Interior, in his discretion, may grant to a permittee or lessee of lands containing sodium deposits, and subject to the payment of an annual rental of not less than 25 cents per acre, the [illegible] right to use, during the life of the permit or lease, a tract of unoccupied nonmineral public land, not exceeding forty acres in area, for camp sites, refining works, and other purposes connected with and necessary to the proper development and use of the deposits covered by the permit or lease.

Use of unoccupied lands for development work, etc.

Rental.

General provisions.

GENERAL PROVISIONS APPLICABLE TO COAL, PHOSPHATE, SODIUM, OIL, OIL SHALE, AND GAS LEASES.

Permits may be canceled for want of diligence.

SEC. 26. That the Secretary of the Interior shall reserve and may exercise the authority to cancel any prospecting permit upon failure by the permittee to exercise due diligence in the prosecution of the prospecting work in accordance with the terms and conditions stated in the permit, and shall insert in every such permit issued under the provisions of this Act appropriate provisions for its cancellation by him.

Holdings restricted. Coal, phosphate, and sodium.

Oil or gas.

SEC. 27. That no person, association, or corporation, except as herein provided, shall take or hold more than one coal, phosphate, or sodium lease during the life of such lease in any one State; no person, association, or corporation shall take or hold, at one time, more than three oil or gas leases granted hereunder in any one State, and not more than one lease within the geologic structure of the same producing oil or gas field; no corporation shall hold any interest as a stockholder of another corporation in more than such number of leases; and no person or corporation shall take or hold any interest or interests as a member of an association or associations or as a stockholder of a corporation or corporations holding a lease under the provisions hereof, which, together with the area embraced in any direct holding of a lease under this Act, or which, together with any other interest or interests as a member of an association or associations or as a stockholder of a corporation or corporations holding a lease under the provisions hereof, for any kind of mineral leased hereunder, exceeds in the aggregate an amount equivalent to the maximum number of acres of the respective kinds of minerals allowed to any one lessee under this Act. Any interests held in violation of this Act shall be forfeited to the United States by appropriate proceedings instituted by the Attorney General for that purpose in the United States district court for the district in which the property, or some part thereof, is located, except that any ownership or interest forbidden in this Act which may be acquired by descent, will, judgment, or decree may be held for two years and not longer after its acquisition: *Provided*, That nothing herein contained shall be construed to limit sections 18, 18a, 19, and 22 or to prevent any number of lessees under the provisions of this Act from combining their several interests so far as may be necessary for the purposes of constructing and carrying on the business of a refinery, or of establishing and constructing as a common carrier a pipe line or lines of railroads to be operated and used by them jointly in the transportation of oil from their several wells, or from the wells of other lessees under this Act, or the transportation of coal: *Provided further*, That any combination for such purpose or purposes shall be subject to the approval of the Secretary of the Interior on application to him for permission to form the same: *And provided further*, That if any of the lands or deposits leased under the provisions of this Act shall be subleased, trusteed, possessed, or controlled by any device permanently, temporarily, directly, indirectly, tacitly, or in any manner whatsoever, so that they form part of, or are in anywise controlled by any combination in the form of an unlawful trust, with consent of lessee, or form the subject of any contract or conspiracy in restraint of trade in the mining or selling of coal, phosphate, oil, oil shale, gas, or sodium entered into by the lessee, or any agreement or understanding, written, verbal, or otherwise to which such lessee shall be a party, of which his or its output is to be or become the subject, to control the price or prices thereof or of any holding of such lands by any individual, partnership, association, corporation, or control, in excess of the amounts of lands provided in this Act, the lease thereof shall be forfeited by appropriate court proceedings.

Corporation interests.

Interests in other leases.

Forfeiture of prohibited interests.

Temporary holding by descent, etc.

Provisos.
Exceptions.
Ante, pp. 443–446.

Combinations for refineries, pipe lines, etc., permitted.

Coal roads.

Approval necessary.

Forfeiture for subleasing, etc., to combinations in restraint of trade, etc.

Rights of way for pipe lines granted through public lands.

SEC. 28. That rights of way through the public lands, including the forest reserves, of the United States are hereby granted for pipeline purposes for the transportation of oil or natural gas to any applicant possessing the qualifications provided in section 1 of this Act, to the extent of the ground occupied by the said pipe line and twenty-five feet on each side of the same under such regulations as to survey, location, application, and use as may be prescribed by the Secretary of the Interior and upon the express condition that such pipe lines shall be constructed, operated, and maintained as common carriers: *Provided*, That the Government shall in express terms reserve and shall provide in every lease of oil lands hereunder that the lessee, assignee, or beneficiary, if owner, or operator or owner of a controlling interest in any pipe line or of any company operating the same which may be operated accessible to the oil derived from lands under such lease, shall at reasonable rates and without discrimination accept and convey the oil of the Government or of any citizen or company not the owner of any pipe line, operating a lease or purchasing gas or oil under the provisions of this Act: *Provided further*, That no right of way shall hereafter be granted over said lands for the transportation of oil or natural gas except under and subject to the provisions, limitations, and conditions of this section. Failure to comply with the provisions of this section or the regulations prescribed by the Secretary of the Interior shall be ground for forfeiture of the grant by the United States district court for the district in which the property, or some part thereof, is located in an appropriate proceeding.

Ante, p. 437.
Operating conditions, etc.

Proviso.
Express condition for conveyance of oil of other producers, etc.

Applicable to all future grants.

Forfeiture for violations.

Joint use of easements, etc., reserved.

SEC. 29. That any permit, lease, occupation, or use permitted under this Act shall reserve to the Secretary of the Interior the right to permit upon such terms as he may determine to be just, for joint or several use, such easements or rights of way, including easements in tunnels upon, through, or in the lands leased, occupied, or used as may be necessary or appropriate to the working of the same, or of other lands containing the deposits described in this Act, and the treatment and shipment of the products thereof by or under authority of the Government, its lessees, or permittees, and for other public purposes: *Provided*, That said Secretary, in his discretion, in making any lease under this Act, may reserve to the United States the right to lease, sell, or otherwise dispose of the surface of the lands embraced within such lease under existing law or laws hereafter enacted, in so far as said surface is not necessary for use of the lessee in extracting and removing the deposits therein: *Provided further*, That if such reservation is made it shall be so determined before the offering of such lease: *And provided further*, That the said Secretary, during the life of the lease, is authorized to issue such permits for easements herein provided to be reserved.

Provisos.
Disposal of surface of lands leased.

Determination before offering of lease.

Easement periods.

Assignments, etc., of leases restricted.

Relinquishment allowed.

SEC. 30. That no lease issued under the authority of this Act shall be assigned or sublet, except with the consent of the Secretary of the Interior. The lessee may, in the discretion of the Secretary of the Interior, be permitted at any time to make written relinquishment of all rights under such a lease, and upon acceptance thereof be thereby relieved of all future obligations under said lease, and may with like consent surrender any legal subdivision of the area included within the lease. Each lease shall contain provisions for the purpose of insuring the exercise of reasonable diligence, skill, and care in the operation of said property; a provision that such rules for the safety and welfare of the miners and for the prevention of undue waste as may be prescribed by said Secretary shall be observed, including a restriction of the workday to not exceeding eight hours in any one day for underground workers except in cases of emergency; provisions prohibiting the employment of any boy under the age of

Restrictive provisions, for diligence, safety, etc.

Labor restrictions.

sixteen or the employment of any girl or woman, without regard to age, in any mine below the surface; provisions securing the workmen complete freedom of purchase; provision requiring the payment of wages at least twice a month in lawful money of the United States, and providing proper rules and regulations to insure the fair and just weighing or measurement of the coal mined by each miner, and such other provisions as he may deem necessary to insure the sale of the production of such leased lands to the United States and to the public at reasonable prices, for the protection of the interests of the United States, for the prevention of monopoly, and for the safeguarding of the public welfare: *Provided*, That none of such provisions shall be in conflict with the laws of the State in which the leased property is situated.

Sale to the Government, antitrust protection, etc.

Proviso.
State laws not impaired.

Forfeiture of leases.
Proceedings in district courts.

SEC. 31. That any lease issued under the provisions of this Act may be forfeited and canceled by an appropriate proceeding in the United States district court for the district in which the property, or some part thereof, is located whenever the lessee fails to comply with any of the provisions of this Act, of the lease, or of the general regulations promulgated under this Act and in force at the date of the lease; and the lease may provide for resort to appropriate methods for the settlement of disputes or for remedies for breach of specified conditions thereof.

Settlement of disputes, etc.

Regulations, etc., to be prescribed.

SEC. 32. That the Secretary of the Interior is authorized to prescribe necessary and proper rules and regulations and to do any and all things necessary to carry out and accomplish the purposes of this Act, also to fix and determine the boundary lines of any structure, or oil or gas field, for the purposes of this Act: *Provided*, That nothing in this Act shall be construed or held to affect the rights of the States or other local authority to exercise any rights which they may have, including the right to levy and collect taxes upon improvements, output of mines, or other rights, property, or assets of any lessee of the United States.

Proviso.
Rights of States, etc., not affected.

Sworn statements, etc.

SEC. 33. That all statements, representations, or reports required by the Secretary of the Interior under this Act shall be upon oath, unless otherwise specified by him, and in such form and upon such blanks as the Secretary of the Interior may require.

Application of Act to all deposits on reserved lands.

SEC. 34. That the provisions of this Act shall also apply to all deposits of coal, phosphate, sodium, oil, oil shale, or gas in the lands of the United States, which lands may have been or may be disposed of under laws reserving to the United States such deposits, with the right to prospect for, mine, and remove the same, subject to such conditions as are or may hereafter be provided by such laws reserving such deposits.

Disposal of receipts.
To the Treasury.

SEC. 35. That 10 per centum of all money received from sales, bonuses, royalties, and rentals under the provisions of this Act, excepting those from Alaska, shall be paid into the Treasury of the United States and credited to miscellaneous receipts; for past production 70 per centum, and for future production 52½ per centum of the amounts derived from such bonuses, royalties, and rentals shall be paid into, reserved, and appropriated as a part of the reclamation fund created by the Act of Congress, known as the Reclamation Act, approved June 17, 1902, and for past production 20 per centum, and for future production 37½ per centum of the amounts derived from such bonuses, royalties, and rentals shall be paid by the Secretary of the Treasury after the expiration of each fiscal year to the State within the boundaries of which the leased lands or deposits are or were located, said moneys to be used by such State or subdivisions thereof for the construction and maintenance of public roads or for the support of public schools or other public educational institutions, as the legislature of the State may direct: *Provided*, That all moneys which may accrue to the United States under the

To the reclamation fund.
Vol. 32, p. 388.

To the States in which lands located, for roads, education, etc.

Proviso.
From naval petroleum reserves to the Treasury.

provisions of this Act from lands within the naval petroleum reserves shall be deposited in the Treasury as "Miscellaneous receipts."

Oil or gas royalties payable in kind.

SEC. 36. That all royalty accruing to the United States under any oil or gas lease or permit under this Act on demand of the Secretary of the Interior shall be paid in oil or gas.

Sales by competitive bidding.

Upon granting any oil or gas lease under this Act, and from time to time thereafter during said lease, the Secretary of the Interior shall, except whenever in his judgment it is desirable to retain the same for the use of the United States, offer for sale for such period as he may determine, upon notice and advertisement on sealed bids or at public auction, all royalty oil and gas accruing or reserved to the United States under such lease. Such advertisement and sale shall reserve to the Secretary of the Interior the right to reject all bids whenever within his judgment the interest of the United States demands; and in cases where no satisfactory bid is received or where the accepted bidder fails to complete the purchase, or where the Secretary of the Interior shall determine that it is unwise in the public interest to accept the offer of the highest bidder, the Secretary of the Interior, within his discretion, may readvertise such royalty for sale, or sell at private sale at not less than the market price for such period, or accept the value thereof from the lessee: *Provided, however,* That pending the making of a permanent contract for the sale of any royalty, oil or gas as herein provided, the Secretary of the Interior may sell the current product at private sale, at not less than the market price: *And provided further,* That any royalty, oil, or gas may be sold at not less than the market price at private sale to any department or agency of the United States.

Action on bids.

Readvertising, private sales, etc.

Provisos.
Disposal of current product at market price.

Sales to the Government.

Provisions applicable to all deposits of coal, etc.

Oil Creek Coal Company included.
Vol. 37, p. 1345.

SEC. 37. That the deposits of coal, phosphate, sodium, oil, oil shale, and gas, herein referred to, in lands valuable for such minerals, including lands and deposits described in the joint resolution entitled "Joint resolution authorizing the Secretary of the Interior to permit the continuation of coal mining operations on certain lands in Wyoming," approved August 1, 1912 (Thirty-seventh Statutes at Large, page 1346), shall be subject to disposition only in the form and manner provided in this Act, except as to valid claims existent at date of the passage of this Act and thereafter maintained in compliance with the laws under which initiated, which claims may be perfected under such laws, including discovery.

Perfection of valid claims allowed.

Land office fees to be prescribed.

SEC. 38. That, until otherwise provided, the Secretary of the Interior shall be authorized to prescribe fees and commissions to be paid registers and receivers of United States land offices on account of business transacted under the provisions of this Act.

Approved, February 25, 1920.

February 25, 1920.
[S. 791.]
[Public, No. 147.]

CHAP. 86.—An Act For furnishing water supply for miscellaneous purposes in connection with reclamation projects.

Reclamation projects.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Secretary of the Interior in connection with the operations under the reclamation law is hereby authorized to enter into contract to supply water from any project irrigation system for other purposes than irrigation, upon such conditions of delivery, use, and payment as he may deem proper: *Provided,* That the approval of such contract by the water users' association or associations shall have first been obtained: *Provided,* That no such contract shall be entered into [illegible] there is no other practicable source of water supply for the purpose: *Provided further,* That no water shall be furnished for the uses named if the delivery of such water shall be detrimental to the water

Water from, allowed for other than irrigation.

Provisos.
Consent of water users.
Necessity required.

If not detrimental to irrigation service.



Public Law 585

CHAPTER 730

August 13, 1954
[S. 3344]

AN ACT

To amend the mineral leasing laws and the mining laws to provide for multiple mineral development of the same tracts of the public lands, and for other purposes.

Mineral leasing claims.
Preference categories.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That (a) subject to the conditions and provisions of this Act and to any valid intervening rights acquired under the laws of the United States, any mining claim located under the mining laws of the United States subsequent to July 31, 1939, and prior to February 10, 1954, on lands of the United States, which at the time of location were—

(1) included in a permit or lease issued under the mineral leasing laws; or

(2) covered by an application or offer for a permit or lease which had been filed under the mineral leasing laws; or

(3) known to be valuable for minerals subject to disposition under the mineral leasing laws,

shall be effective to the same extent in all respects as if such lands at the time of location, and at all times thereafter, had not been so included or covered or known: *Provided, however*, That, in order to be entitled to the benefits of this Act, the owner of any such mining claim located prior to January 1, 1953, must have posted and filed for record, within the time allowed by the provisions of the Act of August 12, 1953 (67 Stat. 539), an amended notice of location as to such mining claim, stating that such notice was filed pursuant to the provisions of said Act of August 12, 1953, and for the purpose of obtaining the benefits thereof: *And provided further*, That in order to obtain the benefits of this Act, the owner of any such mining claim located subsequent to December 31, 1952, and prior to February 10, 1954, not later than one hundred and twenty days after the date of enactment of this Act, must post on such claim in the manner required for posting notice of location of mining claims and file for record in the office where the notice or certificate of location of such claim is of record an amended notice of location for such claim, stating that such notice is filed pursuant to the provisions of this Act and for the purpose of obtaining the benefits thereof and, within said one hundred and twenty day period, if such owner shall have filed a uranium lease application as to the tract covered by such mining claim, must file with the Atomic Energy Commission a withdrawal of such uranium lease application or, if a uranium lease shall have issued pursuant thereto, a release of such lease, and must record a notice of the filing of such withdrawal or release in the county office wherein such notice or certificate of location shall have been filed for record.

30 USC 501-504.

Labor and improvements.

(b) Labor performed or improvements made after the original location of and upon or for the benefit of any mining claim which shall be entitled to the benefits of this Act under the provisions of subsection (a) of this section 1, shall be recognized as applicable to such mining claim for all purposes to the same extent as if the validity of such mining claim were in no respect dependent upon the provisions of this Act.

Withdrawal of lands, etc.

(c) As to any land covered by any mining claim which is entitled to the benefits of this Act under the provisions of subsection (a) of this section 1, any withdrawal or reservation of lands made after the original location of such mining claim is hereby modified and amended so that the effect thereof upon such mining claim shall be the same as if such mining claim had been located upon lands of the United States which, subsequent to July 31, 1939, and prior to the date of such with-

drawal or reservation, were subject to location under the mining laws of the United States.

SEC. 2. (a) If any mining claim which shall have been located subsequent to December 31, 1952, and prior to December 11, 1953, and which shall be entitled to the benefits of this Act, shall cover any lands embraced within any mining claim which shall have been located prior to January 1, 1953, and which shall be entitled to the benefits of this Act, then as to such area of conflict said mining claim so located subsequent to December 31, 1952, shall be deemed to have been located December 11, 1953.

(b) If any mining claim hereafter located shall cover any lands embraced within any mining claim which shall have been located prior to February 10, 1954, and which shall be entitled to the benefits of this Act, then as to such area of conflict said mining claim hereafter located shall be deemed to have been located one hundred and twenty-one days after the date of the enactment of this Act.

Uranium leases, etc.

SEC. 3. (a) Subject to the conditions and provisions of this Act and to any valid prior rights acquired under the laws of the United States, the owner of any pending uranium lease application or of any uranium lease shall have, for a period of one hundred and twenty days after the date of enactment of this Act, as limited in subsection (b) of this section 3, the right to locate mining claims upon the lands covered by said application or lease.

(b) Any rights under any such mining claim so hereafter located pursuant to the provisions of subsection (a) of this section 3 shall be subject to any rights of the owner of any mining claim which was located prior to February 10, 1954, and which was valid at the date of the enactment of this Act or which may acquire validity under the provisions of this Act. As to any lands covered by a uranium lease and also by a pending uranium lease application, the right of mining location under this section 3, as between the owner of said lease and the owner of said application, shall be deemed as to such conflict area to be vested in the owner of said lease. As to any lands embraced in more than one such pending uranium lease application, such right of mining location, as between the owners of such conflicting applications, shall be deemed to be vested in the owner of the prior application. Priority of such an application shall be determined by the time of posting on a tract then available for such leasing of a notice of lease application in accordance with paragraph (c) of the Atomic Energy Commission's Domestic Uranium Program Circular 7 (10 C. F. R. 60.7 (c)) provided there shall have been timely compliance with the other provisions of said paragraph (c) or, if there shall not have been such timely compliance, then by the time of the filing of the uranium lease application with the Atomic Energy Commission. Any rights under any mining claim located under the provisions of this section 3 shall terminate at the expiration of thirty days after the filing for record of the notice or certificate of location of such mining claim unless, within said thirty-day period, the owner of the uranium lease application or uranium lease upon which the location of such mining claim was predicated shall have filed with the Atomic Energy Commission a withdrawal of said application or a release of said lease and shall have recorded a notice of the filing of such withdrawal or release in the county office wherein such notice or certificate of location shall be of record.

(c) Except as otherwise provided in subsections (a) and (b) of this section 3, no mining claim hereafter located shall be valid as to any lands which at the time of such location were covered by a uranium lease application or a uranium lease. Any tract upon which a notice of lease application has been posted in accordance with said para-

graph (c) of said Circular 7 shall be deemed to have been included in a uranium lease application from and after the time of the posting of such notice of lease application: *Provided*, That there shall have been timely compliance with the other provisions of said paragraph (c) or, if there shall not have been such timely compliance, then from and after the time of the filing of a uranium lease application with the Atomic Energy Commission.

Future mining claims, etc.

SEC. 4. Every mining claim or millsite—

(1) heretofore located under the mining laws of the United States which shall be entitled to benefits under the first three sections of this Act; or

(2) located under the mining laws of the United States after the effective date of passage of this Act, shall be subject, prior to issuance of a patent therefor, to a reservation to the United States of all Leasing Act minerals and of the right (as limited in section 6 hereof) of the United States, its lessees, permittees, and licensees to enter upon the land covered by such mining claim or millsite and to prospect for, drill for, mine, treat, store, transport, and remove Leasing Act minerals and to use so much of the surface and subsurface of such mining claim or millsite as may be necessary for such purposes, and whenever reasonably necessary, for the purpose of prospecting for, drilling for, mining, treating, storing, transporting, and removing Leasing Act minerals on and from other lands; and any patent issued for any such mining claim or millsite shall contain such reservation as to, but only as to, such lands covered thereby which at the time of the issuance of such patent were—

Mineral reservation to U. S.

(a) included in a permit or lease issued under the mineral leasing laws; or

(b) covered by an application or offer for a permit or lease filed under the mineral leasing laws; or

(c) known to be valuable for minerals subject to disposition under the mineral leasing laws.

Location.

SEC. 5. Subject to the conditions and provisions of this Act, mining claims and millsites may hereafter be located under the mining laws of the United States on lands of the United States which at the time of location are—

(a) included in a permit or lease issued under the mineral leasing laws; or

(b) covered by an application or offer for a permit or lease filed under the mineral leasing laws; or

(c) known to be valuable for minerals subject to disposition under the mineral leasing laws;

to the same extent in all respects as if such lands were not so included or covered or known.

Mining and Leasing Act operations.

SEC. 6. (a) Where the same lands are being utilized for mining operations and Leasing Act operations, each of such operations shall be conducted, so far as reasonably practicable, in a manner compatible with such multiple use.

(b) Any mining operations pursuant to rights under any unpatented or patented mining claim or millsite which shall be subject to a reservation to the United States of Leasing Act minerals as provided in this Act, shall be conducted, so far as reasonably practicable, in a manner which will avoid damage to any known deposit of any Leasing Act mineral. Subject to the provisions of subsection (d) of this section 6, mining operations shall be so conducted as not to endanger or [illegible] any existing surface or underground improvements, workings, or facilities which may have been made for the purpose of Leasing Act operations, or with the utilization of such improvements, workings, or facilities.

(c) Any Leasing Act operations on lands covered by an unpatented or patented mining claim or millsite which shall be subject to a reservation to the United States of Leasing Act minerals as provided in this Act shall be conducted, so far as reasonably practicable, in a manner which will avoid damage to any known deposit of any mineral not so reserved from such mining claim or millsite. Subject to the provisions of subsection (d) of this section 6, Leasing Act operations shall be so conducted as not to endanger or materially interfere with any existing surface or underground improvements, workings, or facilities which may have been made for the purpose of mining operations, or with the utilization of such improvements, workings, or facilities.

(d) If, upon petition of either the mining operator or the Leasing Act operator, any court of competent jurisdiction shall find that a particular use in connection with one of such operations cannot be reasonably and properly conducted without endangering or materially interfering with the then existing improvements, workings, or facilities of the other of such operations or with the utilization thereof, and shall find that under the conditions and circumstances, as they then appear, the injury or damage which would result from denial of such particular use would outweigh the injury or damage which would result to such then existing improvements, workings, or facilities or from interference with the utilization thereof if that particular use were allowed, then and in such event such court may permit such use upon payment (or upon furnishing of security determined by the court to be adequate to secure payment) to the party or parties who would be thus injured or damaged, of an amount to be fixed by the court as constituting fair compensation for the then reasonably contemplated injury or damage which would result to such then existing improvements, workings, or facilities or from interference with the utilization thereof by reason of the allowance of such particular use.

(e) Where the same lands are being utilized for mining operations and Leasing Act operations, then upon request of the party conducting either of said operations, the party conducting the other of said operations shall furnish to and at the expense of such requesting party copies of any information which said other party may have, as to the situs of any improvements, workings, or facilities theretofore made upon such lands, and upon like request, shall permit such requesting party, at the risk of such requesting party, to have access at reasonable times to any such improvements, workings, or facilities for the purpose of surveying and checking or determining the situs thereof. If damage to or material interference with a party's improvements, workings, facilities, or with the utilization thereof shall result from such party's failure, after request, to so furnish to the requesting party such information or from denial of such access, such failure or denial shall relieve the requesting party of any liability for the damage or interference resulting by reason of such failure or denial. Failure of a party to furnish requested information or access shall not impose upon such party any liability to the requesting party other than for such costs of court and attorney's fees as may be allowed to the requesting party in enforcing by court action the obligations of this section as to the furnishing of information and access. The obligation hereunder of any party to furnish requested information shall be limited to map and survey information then available to such party with respect to the situs of improvements, workings, and facilities, and the furnishing thereof shall not be deemed to constitute any representation as to the accuracy of such information.

Unpatented mining claims.

SEC. 7. (a) Any applicant, offeror, permittee, or lessee under the mineral leasing laws may file in the office of the Secretary of the

Procedure for determination.
Filing of notice.

Interior, or in such office as the Secretary may designate, a request for publication of notice of such application, offer, permit, or lease, provided expressly, that not less than ninety days prior to the filing of such request for publication there shall have been filed for record in the county office of record for the county in which the lands covered thereby are situate a notice of the filing of such application or offer or of the issuance of such permit or lease which notice shall set forth the date of such filing or issuance, the name and address of the applicant, offeror, permittee or lessee and the description of the lands covered by such application, offer, permit or lease, showing the section or sections of the public land surveys which embrace the lands covered by such application, offer, permit, or lease, or if such lands are unsurveyed, either the section or sections which would probably embrace such lands when the public lands surveys are extended to such lands or a tie by courses and distances to an approved United States mineral monument.

The filing of such request for publication shall be accompanied by a certified copy of such recorded notice and an affidavit or affidavits of a person or persons over twenty-one years of age setting forth that the affiant or affiants have examined the lands involved in a reasonable effort to ascertain whether any person or persons were in actual possession of or engaged in the working of such lands or any part thereof, and, if no person or persons were found to be in actual possession of or engaged in the working of said lands or any part thereof on the date of such examination, setting forth such fact, or, if any person or persons were so found to be in actual possession or engaged in such working on the date of such examination, setting forth the name and address of each such person, unless affiant shall have been unable through reasonable inquiry to obtain information as to the name and address of any such person, in which event the affidavit shall set forth fully the nature and results of such inquiry.

The filing of such request for publication shall also be accompanied by the certificate of a title or abstract company, or of a title abstractor, or of an attorney, based upon such company's, abstractor's, or attorney's examination of the instruments affecting the lands involved, of record in the public records of the county in which said lands are situate as shown by the indices of the public records in the county office of record for said county, setting forth the name of any person disclosed by said instruments to have an interest in said lands under any unpatented mining claim heretofore located, together with the address of such person if disclosed by such instruments of record.

Thereupon the Secretary of the Interior, or his designated representative, at the expense of the requesting person (who, prior to the commencement of publication, must furnish the agreement of the publisher to hold such requesting person alone responsible for charges of publication), shall cause notice of such application, offer, permit, or lease to be published in a newspaper having general circulation in the county in which the lands involved are situate.

Such notice shall describe the lands covered by such application, offer, permit, or lease, as provided heretofore in the notice to be filed in the office of record of the county in which the lands covered are situate, and shall notify whomever it may concern that if any person claiming or asserting under, or by virtue of, any unpatented mining claim heretofore located, any right or interest in Leasing Act minerals as to such lands or any part thereof [illegible] in the land office where such request for publication was filed (which office shall be specified in such notice) and within one hundred fifty days from the date of the first publication of such notice (which date shall be specified in

such notice), a verified statement which shall set forth, as to such unpatented mining claim:

(1) The date of location;

(2) The book and page of recordation of the notice or certificate of location;

(3) The section or sections of the public land surveys which embrace such mining claim; or if such lands are unsurveyed, either the section or sections which would probably embrace such mining claim when the public land surveys are extended to such lands or a tie by courses and distances to an approved United States mineral monument;

(4) Whether such claimant is a locator or purchaser under such location; and

(5) The name and address of such claimant and names and addresses so far as known to the claimant of any other person or persons claiming any interest or interests in or under such unpatented mining claim;

such failure shall be conclusively deemed (i) to constitute a waiver and relinquishment by such mining claimant of any and all right, title, and interest under such mining claim as to, but only as to, Leasing Act minerals, and (ii) to constitute a consent by such mining claimant that such mining claim and any patent issued therefor, shall be subject to the reservation specified in section 4 of this Act, and (iii) to preclude thereafter any assertion by such mining claimant of any right or title to or interest in any Leasing Act mineral by reason of such mining claim.

If such notice is published in a daily paper, it shall be published in the Wednesday issue for nine consecutive weeks, or, if in a weekly paper, in nine consecutive issues, or, if in a semiweekly or triweekly paper, in the issue of the same day of each week for nine consecutive weeks.

Within fifteen days after the date of first publication of such notice, the person requesting such publication (1) shall cause a copy of such notice to be personally delivered to or to be mailed by registered mail addressed to each person in possession or engaged in the working of the land whose name and address is shown by an affidavit filed as aforesaid, and to each person who may have filed, as to any lands described in said notice, a request for notices, as provided in subsection (d) of this section 7, and shall cause a copy of such notice to be mailed by registered mail to each person whose name and address is set forth in the title or abstract company's or title abstractor's or attorney's certificate filed as aforesaid, as having an interest in the lands described in said notice under any unpatented mining claim heretofore located, such notice to be directed to such person's address as set forth in such certificate; and (2) shall file in the office where said request for publication was filed an affidavit showing that copies have been so delivered or mailed.

(b) If any claimant under any unpatented mining claim heretofore located which embraces any of the lands described in any notice published in accordance with the provisions of sub-section (a) of this section 7 shall fail to file a verified statement, as above provided, within one hundred and fifty days from the date of the first publication of such notice, such failure shall be conclusively deemed, except as otherwise provided in sub-section (e) of this section 7, (i) to constitute a waiver and relinquishment by such mining claimant of any and all right, title, and interest under such mining claim as to, but only as to, Leasing Act minerals, and (ii) to constitute a consent by such mining claimant that such mining claim and any patent issued therefor, shall be subject to the reservation specified in section 4 of this Act, and (iii)

to preclude thereafter any assertion by such mining claimant of any right or title to or interest in any Leasing Act mineral by reason of such mining claim.

(c) If any verified statement shall be filed by a mining claimant as provided in subsection (a) of this section 7, then the Secretary of the Interior or his designated representative shall fix a time and place for a hearing to determine the validity and effectiveness of the mining claimant's asserted right or interest in Leasing Act minerals, which place of hearing shall be in the county where the lands in question or parts thereof are located, unless the mining claimant agrees otherwise. The procedures with respect to notice of such a hearing and the conduct thereof, and in respect to appeals shall follow the then established general procedures and rules of practice of the Department of the Interior in respect to contests or protests affecting public lands of the United States. If, pursuant to such a hearing the final decision rendered in the matter shall affirm the validity and effectiveness of any mining claimant's right or interest under the mining claim as to Leasing Act minerals, then no subsequent proceedings under this section 7 of this Act shall have any force or effect upon the so-affirmed right or interest of such mining claimant under such mining claim. If at any time prior to a hearing the person requesting publication of notice and any person filing a verified statement pursuant to such notice shall so stipulate, then to the extent so stipulated, but only to such extent, no hearing shall be held with respect to rights asserted under that verified statement, and to the extent defined by the stipulation the rights asserted under that verified statement shall be deemed to be unaffected by that particular published notice.

(d) Any person claiming any right in Leasing Act minerals under or by virtue of any unpatented mining claim heretofore located and desiring to receive a copy of any notice of any application, offer, permit, or lease which may be published as above provided in subsection (a) of this section 7, and which may affect lands embraced in such mining claim, may cause to be filed for record in the county office of record where the notice or certificate of location of such mining claim shall have been recorded, a duly acknowledged request for a copy of any such notice. Such request for copies shall set forth the name and address of the person requesting copies and shall also set forth, as to each mining claim under which such person asserts rights in Leasing Act minerals:

(1) the date of location;

(2) the book and page of the recordation of the notice or certificate of location; and

(3) the section or sections of the public land surveys which embrace such mining claim; or if such lands are unsurveyed, either the section or sections which would probably embrace such mining claim when the public land surveys are extended to such lands or a tie by courses and distances to an approved United States mineral monument.

Other than in respect to the requirements of subsection (a) of this section 7 as to personal delivery or mailing of copies of notices and in respect to the provisions of subsection (e) of this section 7, no such request for copies of published notices and no statement or allegation in such request and no recordation thereof shall affect title to any mining claim or to any land or be deemed to constitute constructive notice to any person that the person requesting copies has, or claims, any right, title, or interest in or under any mining claim referred to in such request.

(e) If any applicant, offeror, permittee, or lessee shall fail to comply with the requirements of subsection (a) of this section 7 as to the

personal delivery or mailing of a copy of notice to any person, the publication of such notice shall be deemed wholly ineffectual as to that person or as to the rights asserted by that person and the failure of that person to file a verified statement, as provided in such notice, shall in no manner affect, diminish, prejudice or bar any rights of that person.

Heretofore located claims. Relinquishment of mineral rights.

SEC. 8. The owner or owners of any mining claim heretofore located may, at any time prior to issuance of patent therefor, waive and relinquish all rights thereunder to Leasing Act minerals. The execution and acknowledgment of such a waiver and relinquishment by such owner or owners and the recordation thereof in the office where the notice or certificate of location of such mining claim is of record shall render such mining claim thereafter subject to the reservation referred to in section 4 of this Act and any patent issued therefor shall contain such a reservation, but no such waiver or relinquishment shall be deemed in any manner to constitute any concession as to the date of priority of rights under said mining claim or as to the validity thereof.

Helium lands subject to entry.

SEC. 9. Lands withdrawn from the public domain which are within (a) Helium Reserve Numbered 1, pursuant to Executive orders of March 21, 1924, and January 28, 1926, and (b) Helium Reserve Numbered 2 pursuant to Executive Order 6181 of June 26, 1933, shall be subject to entry and location under the mining laws of the United States, and to permit and lease under the mineral leasing laws, upon determination by the Secretary of the Interior, based upon available geologic and other information, that there is no reasonable probability that operations pursuant to entry or location of the particular lands under the mining laws, or pursuant to a permit or lease of the particular lands under the Mineral Leasing Act, will result in the extraction or cause loss or waste of the helium-bearing gas in the lands of such reserves: *Provided*, That the lands shall not become subject to entry, location, permit, or lease until such time as the Secretary designates in an order published in the Federal Register: *And provided further*, That the Secretary may at any time as a condition to continued mineral operations require the entryman, locator, permittee or lessee to take such measures either above or below the surface of the lands as the Secretary deems necessary to prevent loss or waste of the helium-bearing gas.

41 Stat. 437. 30 USC 22, 181 et seq.

Publication of order in FR.

SEC. 10. The Atomic Energy Act is hereby amended as follows:

(a) Section 5 (b) (5) is revised to read:

60 Stat. 761. 42 USC 1805 (b) (5).

"(5) ACQUISITION.—The Commission is authorized to the extent it deems necessary to effectuate the provisions of this Act—

Post, p. 919. Fissionable source materials.

"(A) to purchase, take, requisition, condemn, or otherwise acquire supplies of fissionable source materials or any interest in real property containing deposits of fissionable source materials; and

"(B) to purchase, take, requisition, condemn, or otherwise acquire rights to enter upon any real property deemed by it to have possibilities of containing deposits of fissionable source materials and to conduct prospecting and exploratory operations for such deposits.

Any purchase made under this paragraph may be made without regard to the provisions of section 3709 of the Revised Statutes (U. S. C., title 41, sec. 5) upon certification by the Commission that such action is necessary in the interest of the common defense and security or upon a showing that advertising is not reasonably practicable, and partial and advance payments may be made thereunder. The Commission may establish guaranteed prices for all fissionable source materials delivered to it within a specified time. Just compensation shall be

made for any property or interest in property purchased, taken, requisitioned, condemned, or otherwise acquired under this paragraph."

42 USC 1805 (b) (6).

(b) Section 5 (b) (6) is revised to read:

"(6) OPERATIONS ON LANDS BELONGING TO THE UNITED STATES.—The Commission is authorized, to the extent it deems necessary to effectuate the provisions of this Act, to issue leases or permits for prospecting for, exploration for, mining, or removal of deposits of fissionable source materials (or for any or all of these purposes) in lands belonging to the United States: *Provided*, That, notwithstanding any other provisions of law, such leases or permits may be issued for lands administered for national park, monument, and wildlife purposes only when the President, by Executive order, finds and declares that such action is necessary in the interests of national defense."

42 USC 1805 (b) (7).

(c) Section 5 (b) (7) is revised to read:

"(7) PUBLIC LANDS.—No individual, corporation, partnership, or association, which had any part, directly or indirectly, in the development of the atomic energy program, may benefit by any location, entry, or settlement upon the public domain made after such individual, corporation, partnership, or association took part in such program, if such individual, corporation, partnership, or association, by reason of having had such part in the development of the atomic energy program, acquired confidential official information as to the existence of deposits of such uranium, thorium, or other fissionable source materials in the specific lands upon which such location, entry, or settlement is made, and subsequent to the date of the enactment of this Act made such location, entry, or settlement or cause the same to be made for his, or its, or their benefit. In cases where any patent, conveyance, lease, permit, or other authorization has been issued, which reserved to the United States fissionable source materials and the right to enter upon the land and prospect for, mine, and remove the same, the head of the department or agency which issued the patent, conveyance, lease, permit, or other authorization shall, on application of the holder thereof, issue a new or supplemental patent, conveyance, lease, permit, or other authorization without such reservation."

42 USC 1801 note.
Supra.
30 USC 501-505.
30 USC 503.

(d) Notwithstanding the provisions of the Atomic Energy Act, and particularly section 5 (b) (7) thereof, prior to its amendment hereby, or the provisions of the Act of August 12, 1953 (67 Stat. 539), and particularly section 3 thereof, any mining claim, heretofore located under the mining laws of the United States, for, or based upon a discovery of a mineral deposit which is a fissionable source material and which, except for the possible contrary construction of said Atomic Energy Act, would have been locatable under such mining laws, shall, insofar as adversely affected by such possible contrary construction, be valid and effective, in all respects to the same extent as if said mineral deposit were a locatable mineral deposit other than a fissionable source material.

"Mineral leasing laws."
48 USC 432-451.
30 USC 22-287 *passim.*

SEC. 11. As used in this Act "mineral leasing laws" shall mean the Act of October 20, 1914 (38 Stat. 741); the Act of February 25, 1920 (41 Stat. 437); the Act of April 17, 1926 (44 Stat. 301); the Act of February 7, 1927 (44 Stat. 1057); and all Acts heretofore or hereafter enacted which are amendatory of or supplementary to any of the foregoing Acts; "leasing Act minerals" shall mean all minerals which, upon the effective date of this Act, are provided in the mineral

"Leasing Act minerals."

"Leasing Act operations."

; "leasing Act operations" shall mean operations conducted under a lease, permit, or license issued under the mineral leasing laws in or incidental to prospecting for, drilling for, mining, treating, storing, transporting, or removing leasing Act minerals; "mining operations" shall mean operations

"Mining operations."

under any unpatented or patented mining claim or millsite in or incidental to prospecting for, mining, treating, storing, transporting, or removing minerals other than Leasing Act minerals and any other use under any claim of right or title based upon such mining claim or millsite; "Leasing Act operator" shall mean any party who shall conduct Leasing Act operations; "mining operator" shall mean any party who shall conduct mining operations; "Atomic Energy Act" shall mean the Act of August 1, 1946 (60 Stat. 755), as amended; "Atomic Energy Commission" shall mean the United States Atomic Energy Commission established under the Atomic Energy Act or any amendments thereof; "fissionable source material" shall mean uranium, thorium, and all other materials referred to in section 5 (b) (1) of the Atomic Energy Act as reserved or to be reserved to the United States; "uranium lease application" shall mean an application for a uranium lease filed with said Commission with respect to lands which would be open for entry under the mining laws except for their being lands embraced within an offer, application, permit, or lease under the mineral leasing laws or lands known to be valuable for minerals leasable under those laws; "uranium lease" shall mean a uranium mining lease issued by said Commission with respect to any such lands; and "person" shall mean any individual, corporation, partnership, or other legal entity.

"Leasing Act operator."
"Mining operator."
42 USC 1801 note.
"AEC."
"Fissionable source material."
42 USC 1805 (b) (1).
"Uranium lease application."
"Uranium lease."
"Person."

SEC. 12. Nothing in this Act shall be construed to waive, amend, or repeal the requirement of any provision of any law for approval of any official of the United States whose approval prior to prospecting, exploring, or mining would be required.

Requirement.

SEC. 13. If any provision of this Act, or the application of such provision to any person or circumstances, is held unconstitutional, invalid, or unenforcible, the remainder of this Act or the application of such provision to persons or circumstances other than those as to which it is held unconstitutional, invalid, or unenforcible, shall not be affected thereby.

Separability.

Approved August 13, 1954.

Public Law 586

CHAPTER 731

AN ACT

August 13, 1954
[S. 3697]

To amend the Act of April 6, 1937, as amended, to include cooperation with the Governments of Canada or Mexico or local Canadian or Mexican authorities for the control of incipient or emergency outbreaks of insect pests or plant diseases.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That section 1 of the Act of April 6, 1937, as amended (7 U. S. C. 148), is further amended by adding at the end thereof the following: "The Secretary of Agriculture is further authorized to cooperate with the Governments of Canada or Mexico or local Canadian or Mexican authorities in carrying out in such countries necessary operations or measures to control incipient or emergency outbreaks of insect pests or plant diseases, when such operations or measures are necessary to protect the agriculture of the United States. In performing the operations or measures authorized under this Act, the cooperating foreign country, State, or local agency shall be responsible for the authority necessary to carry out the operations or measures on all lands and properties within the foreign country or State [illegible] not owned or controlled by the Federal Government and for such other facilities and means as in the discretion of the Secretary of Agriculture are necessary."

Insect pest control.
Canadian-Mexican cooperation.
52 Stat. 344.

Approved August 13, 1954.

.2 Mineral Entries. Rights to mineral lands, excluding the leasable minerals, are initiated by prospecting for minerals thereon, and upon the discovery of a valuable deposit of mineral, the claimant may obtain a patent on the land within the mineral claim (43 CFR, Part 185). Mining claims are of two distinct classes; lode claims and placers. However, the role of the Geological Survey in reporting to the Bureau of Land Management on patent applications of mining claims is to determine whether the lands are "known to be valuable for minerals subject to disposition under the mineral leasing laws." The Multiple Use Act of August 13, 1954 (68 Stat. 708), provides that a reservation of leasable minerals to the United States will be made in issuing patents under the mining laws when the lands are determined to be valuable or valuable prospectively for any such minerals. The Bureau of Land Management determines the sufficiency of the discovery of locatable minerals present as a basis for issuance of a mineral patent for that mineral.

Old known leasing areas are set up to set aside
competitive vs non-competitive lease areas (O&G)
competitive vs prospect permit preference right lease (other minerals)
Not Classification in strict sense.

UNITED STATES
DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY
Conservation Division
Area Geologist's Office
345 Middlefield Road
Menlo Park, California 94025

October 5, 1976

Memorandum

To: Geologists, Office of the Pacific Area Geologist

From: Area Geologist, Pacific Area

Subject: Procedures for identification of multiple mineral conflicts in mineral reports

The Multiple Use Act was passed to provide for multiple mineral development of the same tracts of public lands. However, to assure that no insurmountable problems arise from overlapping operations, it is prudent to identify potentially serious conflicts as early as possible. One convenient time to do this would be in our mineral reports for the mining supervisor and in our processing of a Plan of Operations or Applications for Permit to Drill (APD's) for the Area Oil and Gas and Geothermal Supervisors. Henceforth in our mineral reports we should state (1) whether or not any part of the land in question is valuable for other commodities, (2) whether or not there are any outstanding leases, permits, or applications that inciude any part of the subject lands, and (3) whether the potential for conflict in the development of the two commodities is minor or major. If the potential is major, the appropriate mitigating measures (if any) from a geologic viewpoint should be suggested.

In order to determine what leases, permits, or applications are outstanding it will be necessary to request all the necessary BLM use plats for the townships involved. We eventually hope to have an arrangement with BLM whereby we maintain microfilm files of this information. For the present, however, we will request the "Use plats" on a case-by-case basis. Also, to make sure that we include any locatable minerals, we must refer to our mineral card files and, further, we need to make sure that newly identified mineral occurrences are put on those cards. Also remember to include the date of the Supervisor's request on our mineral reports so that the timeliness of our response will be a matter of record. You are doing a good job, keep up the good work.

Henry L. Cullins

cc: Conservation Manager, Western Region
District Geologist, Los Angeles
Oil and Gas Supervisor, Los Angeles
Area Geothermal Supervisor
Area Mining Supervisor, Alaska-Pacific Area
Chief, Conservation Division

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
Conservation Division
345 Middlefield Road
Menlo Park, California 94025

RECEIVED
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Conservation Division
U.S. GEOLOGICAL SURVEY
Office of Geologist
Menlo Park, California

November 15, 1976

Memorandum

To: All Area Supervisors

From: Acting Conservation Manager, Western Region

Subject: Multiple mineral resource development guidelines

As a result of several discussions with many of you following our meeting early in the year, the following observations and guidelines are presented as a first step in reducing development conflicts where possible in the Western Region.

Leasable versus locatable mineral deposits

With the passage of Public Law 585, provision was made for locating mineral claims in leasing areas. Some of the problems that have or may develop are:

1. Contests of determinations of minerals and associated and related mineral components that are covered by the language and intent of the Mineral Leasing Act as amended.

2. Pressure to accept the "prudent man" value determination method as adopted by the Bureau of Land Management.

3. Contest of "Chiefly valuable" determinations.

4. Possible encroachment by claimants in prospecting permit and lease areas for nuisance or non-development reasons.

Multiple leasable mineral deposits

The Division has found this problem to be of serious proportions in the past and present, especially potash and coal mining versus oil and gas exploration and development in the same area. During the past year potential conflicts have been identified between proposed geothermal leasing and issued sodium and potassium leases, phosphate prospecting permits and developed oil and gas leases, etc.

Guidelines

The Regional organization provides an effective structure for the dissemination of useful resource information among Area offices. You are encouraged to develop contacts to improve the Western Region capabilities in addition to the following to provide early identification of real and potential conflicts:

Pre-lease activities

1. The staff of the Area Geologist's should be alert to potential leasable and locatable mineral conflict areas including documentation of comingled and associated compounds that may result in attempted trespass by claimants. Contacts with appropriate BLM officials should be established to identify such problems for BLM action.

2. The Area Geologist should be asked to participate and provide a mineral report when Division offices are participating in the preparation of pre-lease EAR's with the BLM or Forest Service.

3. Lease sale evaluation committees should assess as a part of their procedures whether potential conflicts exist.

4. Other valuable leaseable minerals, if any, should be reported in existence reports for prospecting permit applications.

5. The Area Geologist should arrange for screening oil and gas and geothermal lease applications for potential conflicts during the clear listing procedure.

Post-lease activities

1. The Area Geologist's should be asked for reported mineral occurrences during the preparation of an EA for proposed operations.

2. The Office of the Area Geologist should be informed if another leasable mineral deposit, such as a coal bed, is penetrated during the drilling of an exploration well to determine the character and extent of such resources that may require protection for future development.

3. Adverse activities of mineral claim locators should be brought to the attention of the BLM to seek available remedies if such is possible.

4. In instances where different lease commodities are sought under applications or leases for the same land, the Area Supervisors affected will develop appropriate stipulations for the guidance of the lessees to allow the efficient recovery of the resources insofar as such may be accomodated. Conflicts between proposed mining activities and geothermal or oil and gas activities will require special investigation and consideration as to whether joint development could be condoned. The Regional Conservation Manager's office is to be informed on all these cases as to the recommendations or appropriate lease stipulations being considered.

Summary

The Area Geologist, by virtue of their resources data and mineral land classi cation responsibilities, will play a major role in identifying potential mine development conflicts. It is necessary to assure the effective flow of resou information to and from those offices, and the cooperation of all offices is expected.

Your observations and comments on the above along with additional suggestions will be welcomed.

In all cases, the Regional Conservation Manager will be briefed as to potenti conflicts and will serve as arbiter as necessary.

Hillary A. Oden

United States Department of the Interior

OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

ORDER NO. 2948

Subject: Division of Responsibility Between the Bureau of Land Management and the Geological Survey for Administration of the Mineral Leasing Laws - Onshore

Sec. 1. Purpose. The purpose of this Order is to set forth the administrative and management procedures for Departmental onshore mineral leasing and operating activities. The spirit and intent of this Order flow from the Department's mineral management objectives of: orderly and timely resources development, protection of the environment, and receipt of fair market value for leased mineral resources.

Sec. 1(a) Orderly and Timely Resource Development includes the Department's responsibilities to:

(1) Foster, promote, and encourage the exploration for and the production of the mineral deposits from the leasable lands; promote competition;

(2) Encourage the active development of the mineral deposits in the leasable lands in a manner compatible with the use of the same lands for other purposes; assure that mineral developers receive the acreage necessary for economic plant investment, development, and production;

(3) Encourage the maximum ultimate recovery of the mineral deposit; prevent waste; promote the conservation of the mineral resources;

(4) Assure adequate minimum production and diligent development requirements for mineral deposits.

(b) Protection of the Environment includes the Department's responsibilities to:

(1) Assure that mineral exploration and production be conducted with the maximum protection of the environment;

(2) Assure the rehabilitation of disturbed lands;

(3) Assure that precautions are taken to protect public health and safety; and

(4) Assure full compliance with the spirit and objectives of the National Environmental Policy Act of 1969, other Federal environmental legislation, and supporting Executive Orders and regulations.

(c) Receipt of Fair Market Value for Leased Mineral Resources includes the Department's responsibilities to assure the public a fair market value return for the use of public lands and the disposition of its mineral resources.

Sec. 2. Agency Responsibilities. The BLM exercises at the Bureau level the Secretary's discretionary authority to determine whether or not leases, permits, and licenses are to be issued. The Bureau of Land Management is responsible for issuing mineral leases, permits, and licenses, and is the office of record in mineral leasing matters. The Geological Survey is responsible for all geologic, engineering, and economic value determinations for the Department's mineral management program. These determinations include: the mineral characteristics of lease and permit areas; parcelling; amounts of bonds; royalties; unit values; rentals; mineral resource evaluations; reserves; investment, diligent development, and minimum production requirements; and all other terms and conditions relating to mineral operations under leases and permits. Geological Survey exercises the Secretary's delegated authority regarding operations conducted within the area of operation by permittees, lessees, and licensees and determines the actions to be taken by them from the standpoint of the development, conservation, and management of mineral resources under the jurisdiction of the Department. GS will refer to BLM any instances of noncompliance with lease terms requiring cancellation action, and BLM will initiate the necessary action.

For the purpose of this Order, the area of operation is defined as that area of the present and planned mine, oil and gas field, or geothermal resource field exploratory, development, and production operations, as presented in an approved exploration or mining plan, drilling permit, oil, gas, or geothermal field development plan, or plan for the abandonment of wells or operations. The area of operation may cover a fraction of a lease or permit area, or it may cover several lease or permit areas. It encompasses the general area needed for storage piles, spoils piles, tailings ponds, on-project mill sites, flow lines, separators, surge tanks, storage tanks, on-project truck or rail-loading stations, drill pads, mud pits, workshops, compressors, generators, on-project power plants, and other such facilities used for on-project mine, oil and gas field, or geothermal resource field exploratory, development, and production operations.

(a) Environmental Protection. The Bureau of Land Management, in cooperation with the Geological Survey, formulates the general requirements to be incorporated in leases, permits, and licenses for the protection of the surface and non-mineral resources and for reclamation. The Geological Survey, before approving exploration and mining plans, drilling permits, oil, gas, or geothermal field development plans, or plans for the abandonment of wells or operations, consults with the Bureau of Land Management on the adequacy of the surface use, environmental protection, and reclamation aspects of the plans and will not grant approval if inconsistent with the BLM's recommendations without further discussions with BLM. If differences remain after these further discussions, the resolution is made by the Assistant Secretary--Mineral Resources and the Assistant Secretary--Public Land Management. If required, the Under Secretary resolves any remaining differences. The BLM is responsible for compliance examinations of environmental protection requirements outside the operating area and for reporting infractions to the GS for discussions with, or orders to, the permittee, lessee, or licensee. GS examines operations to ensure compliance with environmental protection and rehabilitation requirements inside the operating area. With respect to approval of access roads, pipelines, utility routes and other surface uses outside the operating area, the Bureau of Land Management has the primary responsibility but obtains the recommendations of the Geological Survey before taking final action. Orders to operators for any remedial action is the responsibility of the Geological Survey.

(b) Expertise. The Geological Survey is responsible for maintaining engineering, geologic, geophysical, economic, and other technical expertise needed by the Department to assure compliance with applicable laws, operating regulations, and the objectives of the Department's mineral management program. The Bureau of Land Management is responsible for maintaining expertise needed by the Department for action on applications filed with BLM under the mineral leasing laws to assure compliance with applicable laws, leasing regulations, and the objectives of the Department's mineral management program.

(c) Contacts with Applicants.

(1) Prior to the issuance of mineral leases, permits, and licenses, the Bureau of Land Management will represent the Secretary in dealing with applicants.

(2) After issuance and during the exploration, development, and production phases of leases, permits, and licenses, and until a lease, permit, or license has terminated (at which time management is the sole responsibility of BLM) the Geological Survey is the sole representative of the Secretary in all matters relating to the supervision of operations.

Sec. 3. Issuance of Mineral Leases, Permits, and Licenses.

(a) Applications. Prior to the issuance of mineral prospecting permits, leases, or licenses, the Bureau of Land Management refers all applications for such permits, leases, or licenses to the Geological Survey for a report as outlined in (b) below.

(1) The Geological Survey is responsible for determining, under the mineral leasing laws and regulations, if sufficient information is known about a mineral deposit to warrant offering the deposit for lease by competitive sale and to notify the Bureau of Land Management of its determination. If the Geological Survey finds that sufficient information is not available to warrant competitive leasing, it notifies the Bureau of Land Management of its conclusions so that the Bureau of Land Management may issue a prospecting permit or noncompetitive lease, as appropriate. The Geological Survey establishes prospecting requirements for prospecting permits. When lands are to be leased, the Geological Survey determines and reports, as appropriate, on: the mineral characteristics of lease and permit areas; parcelling; amounts of bonds; royalties; unit values; rentals; mineral resource evaluations; reserves; investments; diligent development and minimum production requirements; and all other terms and conditions pertaining to lease operations, including environmental and surface rehabilitation stipulations relating to mineral exploration and extraction. With respect to applications for licenses, the Geological Survey determines and reports as to whether the license may be issued.

(2) The Geological Survey is responsible for determining whether a prospecting permittee has demonstrated that the lands contain a mineral deposit having the characteristics required by law and regulations to qualify for a preference right lease and to notify the Bureau of Land Management.

(3) The Bureau of Land Management refers to the Geological Survey all other type applications received which, if approved, may affect operations on existing permits, leases, or licenses.

(4) The Bureau of Land Management notifies the Geological Survey of known oil, gas, and geothermal resource geophysical exploration activity, including the area involved, the type of survey employed, and the name of the operator.

(5) All applications for noncompetitive oil and gas, mineral, and geothermal resource leases filed with the Bureau of Land Management will, prior to issuance of a lease, be referred to the Geological Survey for a determination as to whether the lands are within a known geologic structure (KGS), a known geothermal resource area (KGRA), or a known leasing area (KLA).

(b) Mineral Resource Evaluation Report. GS is responsible for submitting a report of its findings, mineral resource evaluations, and resultant recommendations to the BLM, together with a summary explanation of how the resource evaluations were developed from geophysical, geologic, economic, and engineering data available at the time of the evaluation. The BLM reviews these findings and recommendations in light of multiple-use management requirements and will not issue leases or permits inconsistent with the findings and recommendations without further discussion with GS. If differences remain after further discussion, the resolution is made by the Assistant Secretary--Mineral Resources and the Assistant Secretary--Public Land Management. If required, the Under Secretary resolves any remaining differences.

(c) Competitive Lease Sales. The Bureau of Land Management advertises and conducts competitive lease sales. The Geological Survey's resource evaluations will be used and the Geological Survey will have representatives at the sale and renders a post-sale recommendation to BLM regarding acceptance or rejection of the bids, which must be confirmed in writing.

(d) Files and Records. BLM maintains the official application, permit, and lease case files and forwards to the Geological Survey a copy of each permit, lease, and license, together with copies of relevant correspondence thereafter conducted by the Bureau. The GS forwards to the BLM copies of mining and exploration plan applications, drilling permit applications, and relevant items submitted by the applicants directly to the GS, except confidential proprietary information cited under paragraph (e) below.

(e) Security of Information. The Geological Survey is responsible for receiving and protecting for the confidential use of the Federal Government all proprietary geological, geophysical, engineering, economic, statistical, or other information, mineral resource data, and well logs required to be submitted under Title 30 CFR, Parts 200, 211, 216, 221, 231, 270, and related regulations. The Survey Office receiving such information is designated the Office of Control for those data. Authorized officials of BLM or other surface-managing agencies having a need to see such information will normally make appropriate arrangements to visit the Office of Control for access to such data and for technical advice based on it pertinent to their management responsibilities.

Sec. 4. Mineral Reports. The Geological Survey is responsible for preparing and submitting to the Bureau of Land Management mineral classification and evaluation reports with respect to the leasable mineral value of lands within proposed exchanges, withdrawals, sales, land entries, or other disposals and all other land transactions. The Geological Survey, upon request, also prepares and furnishes mineral reports and other information to the Bureau of Land Management needed for its use in long-range multiple-use planning or inventory of the public lands.

Sec. 5. General Relationships. Such additional references, reports, interchange of information, and advice shall be made by or between the Bureau of Land Management and Geological Survey as may be necessary to perpetuate or improve current practice and provide effective administration of the mineral leasing laws.

The Bureau of Land Management and the Geological Survey must submit to each other for review and recommendations any proposed changes in standard lease terms, regulations, instructions, or other changes that would affect each agency's management responsibilities.

Sec. 6. Implementation of Order. It is intended that there will be no duplication by the BLM or GS of the functions assigned by this Order. BLM and GS will promptly bring their manuals and instructions into agreement with the terms and the spirit and intent of this Order.

Sec. 7. Revocation. The Secretary's instruction (procedures relating to the administration of the mineral leasing laws - General Land Office and Geological Survey) dated September 22, 1925 (51 L. D. 219) is revoked.

(sgd) Rogers C. B. Morton

OCT - 6 1972

Secretary of the Interior

United States Department of the Interior

GEOLOGICAL SURVEY
RESTON, VIRGINIA 22092

In Reply Refer To:
EGS-MS600

DEC 21 1976

RECEIVED
DEC 30 1976
Conservation Division
U.S. GEOLOGICAL SURVE
Office of the Area Geologis
Menlo Park, California

Memorandum

To: Conservation Managers - Central Region
- Eastern Region
- Western Region

From: Acting Chief, Conservation Division

Subject: Working Agreement, BLM-GS, Onshore Mineral Lease Operations, Exclusive of Oil, Gas, Geothermal, and Oil Shale

Enclosed is a copy of the subject agreement between BLM and GS which establishes cooperative procedures for administering onshore mineral leases under Secretarial Order No. 2948. Please provide a copy to all Area and District Mining Supervisors and Geologists and advise them that the agreement is effective immediately.

Please let us know quickly if any problems arise in interpreting or implementing the agreement.

Russell G. Wayland

Acting Chief, Conservation Division

Enclosure

cc: Area Mining Supvs. - McAlester
- Salt Lake City
- Menlo Park
- Wash., D.C.
- Denver
- Billings
- Carlsbad

Dist. Mining Supvs. - Rolla
- Rock Springs
- Phoenix
- Pocatello
- Portland

Geologists - Wash., D.C.
- Casper
- Denver
- Roswell
- Tulsa
- Anchorage
- Menlo Park

AMERICA'S REVOLUTION BICENTENNIAL 1776-1976

WORKING AGREEMENT
BLM-GS
ONSHORE MINERAL LEASE OPERATIONS
Exclusive of Oil, Gas, Geothermal, and Oil Shale

General

This Agreement supplements and is in accordance with Secretarial Order No. 2948 of October 6, 1972. It establishes the procedures for cooperation between the Bureau of Land Management (BLM) and the Geological Survey (GS) in the administration of onshore mineral lease operations other than those for oil, gas, geothermal resources, and o shale.

This Agreement sets forth the respective functions and responsibilities of the two agencies with respect to operations under Federal mineral leases, permits, and licenses where the Bureau of Land Management is the responsible surface management agency or where reserved minerals are involved.

In the event of conflict between this Agreement and special stipu lations in leases, permits, or licenses pertaining to the respective functions of the two agencies, the provisions of this Agreement will control insofar as they do not affect the rights and obligations of lessees.

Definitions
(Specific to the purposes of this Agreement)

1. "Area of Operations," also "AO," means the area(s) of leased lands required for "operations" as defined herein. The "AO" shall be

established by agreement between the BLM and GS, and shall be delineated on a map or plat that is made part of an approved operating plan or a modification, amendment, or supplement thereof.

2. "BLM" means Bureau of Land Management District Managers in the western States, the Director of the Bureau's Eastern States Office, or the respective responsibilities of those officials, as applicable.

3. "GS" means Area and District Mining Supervisors or Geologists of the Conservation Division of the Geological Survey, or the respective responsibilities of those officials, as applicable.

4. "Lease" means a Federal mineral lease, permit (prospecting testing, or special land use permit for exploration), or license issued by BLM. The name of the specific instrument is used herein where necessary for precise meaning or fuller explanation.

5. "Operating Plan" means the detailed document submitted by the lessee setting forth the methods, procedures, and schedules whereby "operations" are conducted on leased lands, including modifications, amendments, or supplements. Operating plans are normally of two kinds, one for exploration, the other for mining and related activities.

6. "Operations" means those activities, with related facilities, conducted on the lease under an approved operating plan, including (a) surface and underground mineral prospecting, exploration, development, testing, and production; (b) all directly related and auxiliary activities and facilities, such as those for the treatment of the minerals produced and the production and disposal of wastes; (c) all activities and facilities required in reclamation of disturbed lands. Camps or other residential

facilities or communities developed and maintained on leased lands, and the auxiliary activities and facilities incident thereto, are not defined as operations, whether or not they are under the control of the operator, nor will they be included in "Areas of Operations;" nor will aircraft landing sites or access, communications, or transportation routes to or from the "AO."

7. "Technical examination/environmental analysis (TE/EA)" means the technical examination and environmental analysis required by Subpart 3041 of Title 43 CFR.

Responsibilities

I. General

A. The purpose of the "AO" shall be for the division of authority between agencies. It also establishes a point of contact for the operato Within the "AO," GS shall approve all actions and be the point of contact for all actions taken under the authority of the lease, in consultation and consistent with the recommendations of BLM, except as provided in Section 111 B.2.b. Outside the "AO," BLM will approve all actions and be the point of contact for all other actions, in consultation with and consistent with the recommendations of GS.

The GS shall be solely responsible for all exploration, develop mining, and processing operations conducted thereon, including the enforce ment of the surface protection and rehabilitation requirements as set forth in the approved plan and within the "AO."

For additional surface use inside the "AO" and related to production facilities or operations but not covered by an approved plan of operations, the operator shall submit a modified plan of operations to the GS. The GS will not approve any such modified plan for additional surface uses until the requirements of Part III of this Agreement have been satisfied. Applications for multiple use within the "AO" other than those related to operations being conducted under an approved plan of operation must be approved by the BLM. BLM will consult with GS to prevent or reduce any surface use conflicts, such as recreationists or special use permittees, and will not approve any such use within an area of operation (AO) which is contrary to GS recommendations without further discussions with GS. Any unresolved issues will be referred to appropriate Departmental officials for resolution.

B. Proprietary data required from permit or lease applicants, lessees, permittees, licensees, or operators by either the BLM or the GS under applicable regulations or lease or permit terms shall be safeguarded in the files of the authorized receiving agency or agencies, subject to review and inspection in the office holding the files by authorized representatives of either agency, or of other Federal agencies subject to agreed secondary control procedures.

C. Disagreements between the BLM and the GS concerning administration of leased lands and operations covered by this Agreement that cannot be resolved hereunder at successively higher levels shall be referred for resolution to the appropriate Assistant Secretaries or to the Under Secretary as prescribed in Secretarial Order No. 2948.

II. Prior to Lease Issuance, Extension, or Readjustment.

A. Bureau of Land Management will:

1. Be the Secretary's official representative in dealing with applicants for rights under existing public land laws, including the mineral laws.

2. Transmit to the GS two (2) copies of a lease application or BIM offering that has survived adjudication, and request assistance from GS to comply with the requirements of the Department's EMARS Coal Leasing Procedures.

3. Receive and analyze nominations which indicate which areas should or should not be leased, and will display such areas on maps within 60 days, and make such maps available to appropriate State agencies and the public. The call for nominations will provide for submission of an information copy to the appropriate Regional Conservation Manager of GS.

4. Request from GS available data on minerals of economic and potentially economic value to assist in the preparation of the multiple Resource Inventory and analysis portion of the Management Framework Planning Process.

5. Request GS to participate, if appropriate, in public meetings to consider the comparative resource and land use values.

6. After consultation with GS, select proposed tract recommendations from Proposed Coal Leasing Areas.

7. Request assistance and available data from GS for the preparation of Regional Environmental Impact Statements.

8. Request from GS a mineral resources evaluation, supported by a summary explanation and its recommendations thereon.

9. After receiving the GS report and recommendations, arrange with the GS for a joint technical examination of lands identified and recommended by BLM for leasing. This examination will be scheduled and coordinated by the BLM and GS consistent with BLM and GS workloads. BLM will invite appropriate State agencies to participate in such examinations

10. Prepare a draft TE/EA in accordance with BLM manual Release 1791 and 3509, using all data on hand and acquired during the joint technical examination; furnish a draft of the document to the GS for revie and comment; and furnish the GS with a copy of the final document. Appropriate State agencies will be furnished copies of such documents.

11. As the lead agency, unless otherwise determined by the Department, initiate and, jointly with the GS, prepare a site specific, or a supplement to an existing Regional environmental impact statement for the proposed action when one is determined to be necessary.

12. Prepare jointly with GS, such special lease terms and conditions as may be determined to be necessary by the TE/EA and, if any, the EIS. BLM will invite appropriate State agencies to participate as appropriate. Such terms to include bonding and diligent development requirements.

13. Prepare lease sale notice. Schedule sale consistent with BLM and GS workloads.

14. Hold sale, and determine high bidder, after GS and BLM evaluation committee evaluate bids to determine their acceptability, and report whether bids should be accepted or rejected.

15. Issue decision rejecting all bids or award lease to high bidder all else being regular and if appropriate. Require high bidder to comply with all requirements of the lease sale notice and regulations. Return unsuccessful bid deposits promptly. Furnish GS two (2) copies of each lease contract.

B. Geological Survey will:

1. Furnish BLM assistance, as requested, to assure that the requirements of the Department's EMARS Coal Leasing Procedures will be met timely and as scheduled. In this regard, the GS will:

a. Provide assistance to evaluate nominations for lands to be or not to be leased.

b. Provide BLM with, or allow authorized BLM personnel to examine data on minerals of economic and potentially economic value to prepare the Bureau's multiple resource inventory and analysis.

c. Provide BLM assistance by participation in public meetings held to consider the comparative resource and land use value.

d. Consult with and provide assistance in the selection of lease tract recommendations from proposed coal leasing areas.

e. Provide assistance in the preparation of Regional and/or site specific EIS's as necessary.

f. Participate in a joint TE/EA, with BLM and other Federal and State agencies, of lands identified and recommended for leasing. This TE/EA to be scheduled and coordinated consistent with the agencies workloads.

g. Normally within 20 working days after receipt of draft TE/EA report GS will submit its comments to BLM.

h. Participate with BLM in the preparation of special lease terms and conditions determined to be necessary by the TE/EA and, if any, the EIS, for protection of surface and non-mineral values.

i. Furnish BLM an estimated resource value, pre-sale evaluation; such value will consider the cost of complying with necessary environmental lease terms and conditions.

j. Participate at lease sale and post sale evaluations.

2. Furnish a report on lands under application for a prospecting or testing permit which will include the mineral character and mineral land classification of the subject lands, the presence or absence of known valuable deposits or commercially valuable deposits; and when applicable, logical permit units, bonding requirements, and adequate prospecting or testing terms and conditions.

3. Furnish a report on preference right lease applications which will include recommendations on: (1) permittees compliance with the requirements of the permit and, (2) verification of the permittees alleged discovery of a valuable deposit of a leasable mineral (commercial quantities in the case of coal). The report will contain recommendations as to logical mining units, rentals, minimum and/or advance royalty, production royalty, diligent development requirements, bonding, and a summary explanation of each recommendation.

4. Furnish assistance or information requested by BLM as schedul and coordinated by the agencies consistent with BLM and GS workloads. Reports requested by BLM will normally be furnished by GS within 30 days of receiving the request, or GS will notify the BLM in case of unusual delay.

C. Bureau of Land Management and Geological Survey, jointly.

1. Will formulate general requirements and special terms and conditions, based on the TE/EA, to be incorporated in leases for the protection of surface and subsurface resources and the environment and for reclamation of affected lands.

2. Will evaluate competitive lease sale bids received.

3. Will determine proper bonding requirements.

III. During Terms of Leases, Permits, and Licenses

A. Prior to Operations

1. Geological Survey will:

a. When copies of the lease are received, send lessee a copy of the operating regulations which require that no operations may be undertaken on leased lands without an approved operating plan.

b. Furnish BLM recommendations on applications for other surface uses of leased lands that might conflict with subsequent operations Normally, such recommendations will be furnished within 10 working days from receipt of the BLM request.

c. Furnish to the BLM two (2) copies of any proposed plans for review and recommendations on the adequacy of the protection of surface resources and the reclamation proposals.

d. Arrange for joint field inspection by the BLM, the GS, the operator, and other interested parties, including appropriate State officia when such an inspection involving the proposed plan is deemed necessary by either the BLM or the GS.

e. Prepare an environmental assessment (EA)[1/] on a proposed operating plan or a major modification to a proposed or approved operating plan after considering BLM's recommendations for the protection of surface resources and reclamation of lands. The BLM will be furnished a copy of the assessment for review and comment prior to acceptance of the final version.

f. Where privately owned surface is involved in the "AO", the surface use areas, or access thereto, the operator will be required to furnish a copy of the contract or agreement with the private surface owner or a letter setting forth rehabilitation requirements with the private surface owners. Such requirements shall conform to Federal or State surface protection performance standards.

g. Delineate the "AO" and the approved surface use areas within the "AO," including the access route to the "AO" and the surface use areas on the maps provided by the operator and make such map a part of the approved plan of operations. If a field examination is required, the delineation of the surface use areas shall not be made until after the joint field examination and agreement is reached with BLM.

h. As lead agency and with BLM participation, unless otherwise determined by the Department, will prepare the environmental impact statement for a proposed operation when one is determined to be necessary.

1/ Corresponds to BLM environmental analysis record (EAR).

i. Has the sole authority to approve operating plans or major modifications thereto, but will do so only after resolving any differences with the BLM pertaining to the protection of surface resource improvements, and the reclamation of affected lands.

j. Schedule, if appropriate, public meetings or hearings on proposed operating plans, environmental assessments, or environmental statements. Request BLM to participate when necessary and appropriate.

k. Advise the operator that the GS will expect full compliance with the applicable laws, regulations, and the approved plan of operations, and further, that the GS will consider the operator to be fully responsible for the actions of his subcontractors.

l. Furnish immediate notification of all approved plans to the appropriate BLM office.

2. Bureau of Land Mangement will:

a. Retain jurisdiction over all non-lessee activities on leased lands prior to operations.

b. Consult with the GS and request its recommendations before approving or permitting other surface uses of leased lands which might conflict with subsequent operations. No such uses will be approved by BLM until all differences with GS have been resolved.

c. Within 10 working days after receipt of a proposed operating plan from the GS, advise the GS whether or not a joint field inspection of the lands included in the proposal is required.

d. Normally within 30 working days following a joint inspection or receipt of a proposed operating plan, if a joint inspection is

deemed unnecessary, furnish the GS a report and recommendations, supporte by adequate summary explanation, on the surface protection and reclamatic aspects of the proposed plan.

e. If requested, provide assistance to GS in preparation of the draft EA.

f. Review the GS draft EA on a proposed operation prior to acceptance of the final version. Normally, the BLM will furnish its comments within 20 working days from the time the draft is received.

g. Participate, with the GS as the lead agency, unless otherwise determined by the Secretary, in preparing an environmental impact statement covering a proposed operation when one is determined to be required.

B. During Operations

1. Geological Survey will:

a. Be the point of contact and sole representative of the Secretary in dealing with the lessee and/or the operator concerning operations and compliance with lease terms, regulations, and approved operating plans, except in emergency situations as specified in the following item B.2.b.

b. Inspect operations to insure that the operator is in compliance with terms and conditions of the lease and is conducting operations in accordance with the applicable regulations and the approved plan of operations.

c. Report to the BLM infractions of lease terms and incident of noncompliance that may require cancellation of the lease or claims for damages against the lessee.

d. Take the appropriate administrative action upon receiving BLM reports of operator's unauthorized activities outside the area of operations (AO) on leased lands. Any area affected by unauthorized activities may, if appropriate, be included within the area of operations (AO) as a modification thereof.

e. Furnish BLM with the name, address, and both the office and home telephone numbers of the GS Supervisor to contact in case of emergencies or incidents of noncompliance with the surface use and rehabilitation requirements of the lease or approved plan of operations.

f. Seek all available help, including BLM, on major accidents which might result in damage to other resources. Seek BLM expertise in rehabilitation and clean-up operations.

g. Specify abandonment procedures and approve the abandonment of drill holes, adits, shafts, and trenches.

h. Approve final abandonment of operations and recommend release of the operator's bond only upon BLM confirmation of satisfactory reclamation of affected lands.

2. Bureau of Land Management will:

a. Retain surface management jurisdiction over the leased lands outside the area of operations (AO).

(1) Where activities not included in an approved plan of operations constitute unauthorized activity on such lands by the operator these activities will be reported to GS for the appropriate administrative action.

(2) Request and obtain the recommendations of the GS before approving other surface uses of leased lands which might conflict with operations. No such uses will be approved without joint agreement between the GS and BLM.

b. Exercise jurisdiction over activities within the area of operations (AO) only in emergency situations, and may issue orders to the operator only under the following circumstances and conditions:

(1) The emergency situations shall be such as to clearly threaten immediate and serious damage to the environment, resources, or the health and safety of the public, and the Mining Supervisor is not available to take the necessary immediate action.

(2) Order, in such emergency situations, immediate cessation of activities responsible for the emergency situation, such orders to be followed by prompt notification to the GS, who will take over jurisdiction and order immediate remedial action.

c. Report to the GS for appropriate action any observed infractions of lease terms and conditions by the operator when such infractions do not involve emergencies as described in b. above.

d. Upon the request of GS, take such actions as may be necessary toward canceling a lease, or seeking claims for damages against the lessee that result from noncompliance with the lease terms regulations

e. Not release the operator's final bond liability until the GS recommends and the BLM agrees that the affected lands have been satisfactorily conditioned for abandonment upon termination of all operations.

3. Bureau of Land Management and Geological Survey, jointly will

a. Make an annual inspection of the leased lands on which operations are active to evaluate revegetated areas to determine whether additional revegetative efforts may be required. The boundary of the, "Area of Operations" may be reviewed at this time.

b. Upon operator or lessee application for abandonment of operations or the lease, inspect the leased land to determine the adequacy of reclamation and whether the lands are satisfactorily conditioned for abandonment.

c. May agree that the BLM will oversee reclamation on any particular area of operations and assume the Federal responsibility therefc

IV. After Abandonment of Operations and Termination of the Lease

A. Geological Survey

1. The GS, upon approved abandonment of operations and terminatio of the lease and bond, shall relinquish all administrative jurisdiction and authority over the lands.

B. Bureau of Land Management

1. The BLM shall assume all administrative jurisdiction and authority over the lands.

V. Coordination

A. Geological Survey will:

1. Coordinate and communicate with lessees and operators and BLM concerning exploration and development plans and other information requirements prior to submission of proposed plans of operations.

B. Bureau of Land Management will:

1. If requested by GS, communicate with lessees and operators prior to submission of proposed plans of operations to expedite BLM's input concerning surface management and rehabilitation requirements.

C. Bureau of Land Management and Geological Survey, jointly, will:

1. Periodically hold joint inspections or meetings with lessees, operators, contractors, and other involved parties to discuss problems, stipulations, working agreements, and other items of common concern.

2. Meet together periodically to discuss past and future procedures under these instructions.

3. Offer suggestions for revision of these procedures to their Headquarters offices for improving their workability and to reduce duplication of effort in conducting these cooperative activities.

W. A. Radlinski — 11/4/76

Associate Director
U.S. Geological Survey — Date

George C. Hunt — 11/24/76

Associate Director
Bureau of Land Management — Date

Department of the Interior
GEOLOGICAL SURVEY - CONSERVATION DIVISION
BRANCH OF MINERAL CLASSIFICATION MANUAL

.1 Statutory. The following cited acts provide the authority under which the Department of the Interior is charged with the responsibility of the classification of the mineral or waterpower resources on the public domain:

A. March 3, 1879 (20 Stat. 377-394). The "Organic Act", which creates the office of the Director of the Geological Survey with the responsibility for the classification of the public domain.

B. February 26, 1895 (28 Stat. 683). Authorized the Secretary of the Interior to classify Northern Pacific Railroad lands in Montana and Idaho.

C. March 27, 1906 (34 Stat. 88). Authorized the Secretary of the Interior to reclassify public lands in Alabama.

D. June 25, 1910 (36 Stat. 847). Provides the authority of the President to withdraw lands from entry and to reserve such lands for waterpower sites, irrigation, classification, or other public purposes.

E. August 24, 1912 (37 Stat. 497). Amends the act of June 25, 1910, by providing for the location of only metalliferous minerals under the mining laws on withdrawn lands.

F. July 17, 1914 (38 Stat. 509). All lands withdrawn or classified as phosphate, nitrate, potash, oil, gas, or asphaltic mineral, or which are reported as valuable for such deposits, were opened to surface entry with a mineral reservation to the United States.

G. May 24, 1950 (64 Stat. 1262) as amended July 5, 1952 (66 Stat. 121) Transfers to the Secretary of the Interior all functions of other officers of the Department and all functions of all agencies and employees of the Department.

.2 Delegated. The following Departmental, Bureau, and Division orders, regulations, or manuals contain delegations of authority under which the Branch of Mineral Classification is charged with the duties relating to the withdrawals and classifications.

A. Departmental Order No. 2563, May 2, 1950.[1/] Each function transferred to the Secretary of the Interior by Sec. 1 of Reorganization Plan No. 3 of 1950, May 24, 1950, is assigned to the officer, employee, or agency from whom or from which it was transferred.

B. Geological Survey Manual, Organization Series. Part 120.4.1D, October 20, 1959 (Release 310), assigns to the Branch of Mineral Classification the task of the classification of "Federally-owned land as to their mineral values, and (it) performs all activities designed to prevent alienation of Federally-owned mineral values under inapplicable laws;...."

C. Departmental Manual, Public Land Series. In Part 603, Land Withdrawal Program November 20, 1962 (Release 568) 603.1.2A requires that all orders relating to land withdrawals and restorations shall be submitted to the Assistant Secretary for Public Land Management; 603.1.2C reads "The Geological Survey, having primary responsibility for mineral and water power classification, is responsible for continuing review of those classification programs and, in cooperation with the Bureau of Land Management, for initiating classifications and restorations in whole or in part of previous classifications when available information and considered judgment indicate that the continuance of such classifications are no longer in the public interest."

1/ Departmental Order No. 2563 was issued prior to final approval of Reorganization Plan No. 3 of 1950, Sec. 2 of which stated "This order will take effect immediately after Reorganization Plan No. 3 of 1950 becomes effective.

Informal classifications are actions performed by the Washington staff of the Branch of Mineral Classification involving applications for the surface use of public lands. Also included are prospectively valuable determinations by the Classification Committees and Board either on specified areas or on a regional basis supported by geologic data. The determinations made by the Branch require reports on the mineral and water resources of specified tracts of land subject to disposal for surface use under authority of a series of Public Land Laws governing the disposal of lands in the Public Domain for various purposes. Such actions by the Branch are termed "co-ops" as their handling originated under an agreement between the Geological Survey and the old General Land Office (now Bureau of Land Management) dated July 9, 1910, for the cooperative handling of these cases. There has been a number of subsequent revisions and these are listed under 612.1.2.

.1 Statutory. The following cited legislative actions are the principal acts governing settlement or entry on the public domain providing for or which to some degree affect surface entries such as homestead, desert land entries, entries under the reclamation and grazing acts, and the sale of isolated tracts:

A. May 20, 1862 (Rev. Stat. 2289-2303) Homestead Law (12 Stat. 392)
July 9, 1870 (16 Stat. 217) Placer Law
May 10, 1872 (Rev. Stat. 2319) Mining Law (17 Stat. 91)
March 3, 1877 (19 Stat. 377) Desert Land Entries
March 3, 1879 (20 Stat. 377, 394) The "Organic Act" of the Geological Survey
June 17, 1902 (32 Stat. 388) Reclamation Act
March 27, 1906 (34 Stat. 88) Authorized the Secretary of the Interior to reclassify public lands in Alabama
June 11, 1906 (34 Stat. 233) Surface entry on forest reserve land
March 3, 1909 (35 Stat. 844) Agricultural entries on coal land
June 22, 1910 (36 Stat. 583) Separation Act
June 25, 1910 (36 Stat. 847) Withdrawal Act
April 30, 1912 (37 Stat. 105) Separation Act
July 17, 1914 (38 Stat. 509) Agricultural entries on mineral land
June 28, 1934 (48 Stat. 1269) Taylor Grazing Act
May 16, 1946 (60 Stat. 1099) Reorganization Plan No. 3 Creation of Bureau of Land Management
July 31, 1947 (61 Stat. 681) Materials Act
May 24, 1950 (64 Stat. 1262) as amended July 25, 1952; Reorganization Plan No. 3 of 1950. Reorganization Pla No. 3 (64 Stat. 1262) transfers to the Secretary of the Interior all functions of other offices of the Department.
August 13, 1954 (68 Stat. 700) Multiple Use Act
July 7, 1958 (72 Stat. 339) Alaska Statehood Act
August 21, 1958 (72 Stat. 928) State Indemnity selections

.2 Delegated. The Departmental, Bureau, and Division orders, regulations, or manuals contain delegations of authority under which the Branch of Mineral Classification is charged with the duties relating to the mineral land classification of the public domain. Some of the more important follow:

A. July 9, 1910, agreement between Geological Survey and General Land Office provided that the Survey furnish a report in each land entry where lands withdrawn or classified as coal lands are involved.

B. January 11, 1912, Departmental Order, required the Survey to furnish a report on all railroad and State indemnity selections.

C. January 18, 1912, Departmental Order, supplemental order to January 11, 1912, required a report from the Survey on selections, applications, and filings not specifically excepted from reservation by Act of June 25, 1910 (36 Stat. 847), and under which a vested right has not been secured.

D. March 5, 1912, cooperative agreement between the Land Office and the Survey in regard to lands withdrawn or classified as valuable for coal, oil, phosphate, and power site and reservoir withdrawals.

E. February 12, 1917, cooperative agreement of March 5, 1912, extended and water holes included.

F. May 27, 1942, agreement approved by the Secretary that a report will be obtained by the Land Office on mineral and water power resources of land before action is taken on any application to locate, enter, select, or purchase.

G. May 2, 1950, Departmental Order No. 2563. Each function transferred to Secretary of Interior by Sec. 1 of Reorganization Plan No. 3 of 1950 is assigned to the officer, employee, or agency from which it was transferred.

H. Geological Survey Manual, Organization Series. Part 120.4.1D, October 20, 1959 (Release No. 310), assigns to the Branch of Mineral Classification the task of mineral classification of "Federally-owned land".

I. Departmental Manual. Public Land Series, Part 603.1.2C, Land Withdrawal Program, June 11, 1960 (Release No. 290), designates to the Geological Survey primary responsibility for mineral and water power classification.

J. Bureau of Land Management Manual, Vol. V., Lands, Parts 2 and 2A, and Vol VI. Minerals.

United States Department of the Interior

U.S. Geological Survey

OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

JUL 26 1977

ORDER No. 3005

Conservation Division
Western Region
Menlo Park, California

Subject: Redelegation of Authority to Assistant Secretaries, Heads of Bureaus and Offices, and Department Officials

Sec. 1 Purpose. This order provides for a restructuring of the method by which Secretarial authority is redelegated to officials of the Department. In order to strengthen the responsibilities and management control exercised by Assistant Secretaries over the bureaus and offices they supervise, a new system of redelegations of the Secretary's authority is being instituted. Existing delegations of authority to Department officials for general program operations and specified administrative functions will be withdrawn and assumed by the Assistant Secretaries, who in turn, will redelegate appropriate authority to the bureaus, offices, and officials they supervise. The following sections of this order prescribe the temporary arrangements to place this new system into effect.

Sec. 2 Authority. This order is issued in accordance with the authority provided by Section 2 of Reorganization Plan No. 3 of 1950 (64 Stat. 1262).

Sec. 3 Revocation of Authority. Except as provided in Section 8 of this order, all delegations of authority previously made to heads of bureaus and offices, and officials of the Department, are hereby revoked effective this date. Included in this revocation are the provisions of 203 DM 1.

Sec. 4 Amendment of 205 DM. Wherever delegations in Part 205 of the Departmental Manual are made to the head of a bureau and/or an office reporting directly to an Assistant Secretary, such delegations are amended to read "Assistant Secretaries and the Commissioner of Indian Affairs."

Sec. 5 Amendment of 210 DM 1. Paragraph B of the delegation of authority to Assistant Secretaries published in 210 DM 1.2 of the Departmental Manual is amended to read as follows:

"B. The Assistant Secretaries may redelegate the authority delegated to them in 210 DM 1.2A, except where prohibited by statute, Executive Order or limitations established by other competent authority. Such redelegations will be issued in strict compliance with the procedural requirements in Part 200 of the Departmental Manual.

AMERICAN REVOLUTION BICENTENNIAL 1776-1976

U.S. Conservation Division
U.S. GEOLOGICAL SURVEY
Office of the Area Geologist
Menlo Park, California
JUL 29 1977

(1) The Assistant Secretary for Fish and Wildlife and Parks may redelegate the authority currently published in the following Parts of the Departmental Manual: 205 DM, 242 DM, 245 DM, 248 DM, and related Secretarial Orders.

(2) The Assistant Secretary - Energy and Minerals may redelegate the authority currently published in the following Parts of the Departmental Manual and Secretary's Orders: 205 DM, 215 DM, 218 DM, 220 DM, 260 DM, 265 DM, 270 DM, S.O. 2900, and other related Secretarial Orders.

(3) The Assistant Secretary - Land and Water Resources may redelegate the authority currently published in the following Parts and Chapters of the Departmental Manual: 205 DM, 211 DM 6, 235 DM, 255 DM, and related Secretarial Orders."

Sec. 6 Establishment of Redelegations. Upon receipt of this order each Assistant Secretary shall initiate action to prepare documents for appropriate redelegations of authority to the bureaus, offices, and officials they supervise. Such documents will be prepared in accordance with the provisions of Section 7 of this order.

Sec. 7 Procedures for Redelegation Documentation. All redelegations of authority made by Assistant Secretaries pursuant to this order, shall be issued in the form of a Departmental Manual release published in the 200 Series of the Departmental Manual. No other form of redelegation is authorized. The Assistant Secretary - Policy, Budget, and Administration will develop, prescribe, and publish in Part 200 of the Departmental Manual the procedural requirements for the issuance of redelegations of authority made by Assistant Secretaries.

Sec. 8 Exemptions. This order does not apply to nor effect the provisions of:

(a) Secretarial Orders and delegations of authority issued to prescribe the administration and management of territories under the jurisdiction of the Department.

(b) Delegations of authority made to officials and heads of Department organizations which are not under the supervision of an Assistant Secretary.

(c) Delegations of authority to Secretarial Officers published in 210 DM 1 and 210 DM 2, except as provided in Section 5 of this order.

Sec. 9 Effective Date. This order is effective immediately. Its provisions shall remain in effect until it is amended, superseded, or revoked, whichever occurs first. However, in the absence of the foregoing actions, the provisions of this order shall terminate and be considered obsolete on March 31, 1978.

Secretary of the Interior

Date: JUL 8 1977

United States Department of the Interior

GEOLOGICAL SURVEY
RESTON, VIRGINIA 22092

In Reply Refer To:
Mail Stop 640

AUG 31 1977

Memorandum

To: Conservation Manager, Eastern Region
Central Region
Western Region

From: Acting Chief, Conservation Division

Subject: Revocation of authority to sign for the Director, USGS

Secretarial Order 3009, effective July 8, 1977, revoked the delegations of authority under chapter 1, part 203, of the Departmental Manual (203 DM 1). We interpret this revocation as including, among others, the authority delegated to the Director, Geological Survey, for classification of the public lands.

It is our view that until such time as 203 DM 1 is reinstated or a new delegation of authority has been issued, there is no authority below the Assistant Secretary—Energy and Minerals relating to the following actions:

— Co-ops (all land classification, exchange, and disposition actions),

— Definition of Known Leasing Areas (except KGS and KGRA),

— Mineral classification of public lands, and

— Valuable prospective determinations for all leasable minerals.

Authority to sign for the Director in defining Known Geothermal Resource Areas (KGRA's) and Known Geologic Structures (KGS's), although initially revoked by S.O. 3009, has been reinstated by Departmental Manual Release No. 1997 of July 8, 1977.

Until further notice, all final classification actions not involving definitions of KGRA's or KGS's should be withheld, except that classifications requiring prompt action should be forwarded through Headquarters to the Assistant Secretary—Energy and Minerals for signature.

It is our understanding that action has been initiated to redelegate to the Director, Geological Survey, the authority formerly delegated to him by 203 DM 1. Therefore, all preliminary classification actions prior to signature should continue as in the past. We will advise you when a determination regarding the delegation of authority has been made.

Acting Chief, Conservation Division

DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY
GEORGE OTIS SMITH, Director

BULLETIN 537

THE CLASSIFICATION OF THE PUBLIC LANDS

BY

GEORGE OTIS SMITH AND OTHERS



1118

WASHINGTON
GOVERNMENT PRINTING OFFICE
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CONTENTS.

	Page.
The purpose of land classification	7
Development of the Survey's organization for land classification	11
History and legal basis for land classification	18
Introduction	18
Land laws	20
General divisions	20
Public-land laws	20
Agricultural-land laws	20
Purpose	20
Homesteads	21
Forest homesteads	21
Enlarged homesteads	22
Desert land	22
Reclamation act	22
Isolated tracts	22
Timber and stone lands	23
Mineral-land laws	23
General provisions	23
Lodes	24
Placers	25
Building stone	25
Oil	26
Salines	26
Coal-land laws	27
Laws relating to public and quasi-public uses	27
Railroads	27
Irrigation	28
Power	28
Mining and milling	29
Municipal uses	29
Land grants	29
Grants to States	29
In aid of schools and State institutions	29
In aid of internal improvements	30
Carey Act	30
Railroad grants	31
Necessity for land classification	32
Agencies and methods of classification	33
Classification by affidavit of applicant	33
Classification by deputy surveyors	34
Classification by Land Office field service	34
Classification by the Geological Survey	35
Historical sketch	35
Coal lands	36
Oil lands	38
Phosphate lands	39
Potash lands	40
Metalliferous-mineral lands	40

History and legal basis for land classification—Continued.
Agencies and methods of classification—Continued.
Classification by the Geological Survey—Continued. Page.
Water-power sites 41
Reservoir sites 42
Public water reserves 42
Withdrawal acts 43
Separation acts 45
Desirable new legislation 46
Classification of mineral lands 50
Field methods 50
Development 50
Detailed survey 53
Methods used when a topographic base is available 53
Methods used when a base map must be prepared 54
Methods followed when the Land Office survey affords a base map 56
Reconnaissance survey 60
Public-land surveys 61
Preparation of data for classification 63
Coal lands 65
Purpose of classification 65
Methods of classification 66
Principles involved 66
Factors involved 67
Essentials of workability 67
Quality 68
Thickness 69
Depth 78
Classification by 40-acre tracts or lots 78
Outcrop coal and burned coal 78
Methods of valuation 79
Cost of coal in the ground 79
Factors involved 81
Effect of quality on price 82
Effect of mining cost on price 82
Value of thin coals 83
Value of irregular beds 87
Value per acre 90
Reduction for depth 91
Allowance for faults 93
Effect of intrusions 94
Allowance for other factors 94
Reduction for distance from railroad 95
Maximum price 96
Review of classification 96
Regulations for the classification and valuation of public coal lands 96
Restoration 97
Field work on coal lands 98
General nature of the work 98
Location 99
Stratigraphy 99
Extent and thickness of coal beds 100

Classification of mineral lands—Continued.
Coal lands—Continued.
Field work on coal lands—Continued. Page.
Attitude and depth of the coal 103
Quality of the coal 103
Preparation of material 108
Procedure in classification and valuation 108
Progress in classification and valuation 111
Oil and gas lands 111
Occurrence of oil and gas 111
Classification of oil and gas land 117
Phosphate lands 123
Use of phosphate 123
Lands containing phosphate 124
Phosphate reserves 125
Florida reserves 125
Western reserves 126
Summary of phosphate situation 127
Classification of phosphate lands 128
Factors involved 128
Principles controlling classification 129
Regulations 130
Progress in classification 131
Lands bearing potash and related salines 134
Geologic occurrence of the deposits 134
Classification of potash-bearing lands 137
Miscellaneous nonmetalliferous mineral lands 138
Metalliferous mineral lands 142
Purpose of classification 142
Methods of classification 145
Agencies employed 146
Problems involved 146
Preliminary procedure 146
Field work 146
Location and topography 146
Investigation of placer deposits 147
Geologic relations 147
Testing 147
Testimony of miners 147
Investigation of lode deposits 148
Kinds of evidence available 149
General geology 148
Country rock 149
Intrusions and metamorphism 150
Structure 151
Outcrops and float of lodes 151
Prospects and mines 154
Samples and assays 154
History of the region 155
By-products of mineral-land classification 155
Value of collateral information obtained 156
Data of direct interest to the public at large 156
Data relating to prospecting and mining 157
Scientific data 158

	Page.
Classification in relation to water resources	159
General principles of water utilization	159
Classification of water-power sites	161
Preliminary withdrawals	161
Methods of field examination	167
Diversity of conditions	167
Reconnaissance examination	168
Detailed field investigations	172
Compilation of results and revision of withdrawals	174
Adverse claims	175
Nonpower classification	176
Additional requirements to make power classification effective	177
Classification of lands as regards irrigability	178
Field methods	178
General considerations	178
Available water supply	181
Present utilization of water for irrigation	182
Duty of water	183
Character of lands to be irrigated	184
Character of irrigation works	185
Methods of classification	185
Procedure under the Carey Act	186
Irrigation reservoir sites	187
Procedure under the enlarged-homestead acts	187
Classification as regards domestic use	190
General principles	190
Farm water supply	190
Range water supply	191
Municipal water supply	192
Index	193

ILLUSTRATIONS.

	Page.
FIGURE 1. Township map showing classification and valuation of coal lands	68
2. Diagram showing split or broken coal beds and their value for classification	71
3. Diagram showing depth limits of coals of different B. t. u. and of different thicknesses under 6 feet	76
4. Rates paid in the United States for mining coal of specified thicknesses, and curve showing average relation between mining rate and thickness	88
5. Sketch map showing lines along which a coal bed is of equal thickness (isopachous lines), drawn for use in the valuation of coal land	89
6. Reduced copy of diagram used by the United States Geological Survey in computing tonnage and value of coal per acre	92
7. Diagram showing depth to which phosphate deposits are classified under the regulations	181
8. Typical township card from survey records illustrating action	199

THE CLASSIFICATION OF THE PUBLIC LANDS.

By George Otis Smith and others.

THE PURPOSE OF LAND CLASSIFICATION.

In the latter half of the nineteenth century the spirit of the public-land laws in the United States was settlement and development. With a public domain of one and a third billion acres, acquired in the preceding half century—1803–1853—by purchase, discovery, exploration, and cession, and with another third of a billion acres in Alaska constituting a later purchase, the Nation felt that it could be lavish with its lands. The wilderness called for pioneers of every type, and large premiums were held out to capital enterprise and individual initiative. Development was desired whatever the cost in lands that were intrinsically of little value without settlement. The same century that saw the creation of this national domain—an empire in itself—also witnessed the distribution of more than one-half of its acreage. This shrinkage of the national domain has naturally been coincident with national development in all lines of industry. Western prairies have become the world's granary, and western mountains, once wholly in public ownership, are now contributing to their private and corporate owners the profits on no small proportion of the world's output of metals and of mineral fuels.

With advancing years a wise nation, like a prudent man, learns to husband its resources. Land values are now recognized, the purpose in both legislation and administration has changed, and highest development alone is sought. With the most and the best of the Nation's land already alienated, the national duty is to put to its best use what remains.

Utilization of lands for their greatest value necessitates the determination of that value, which is, briefly, land classification; and, to be adequate, land classification must be based upon first-hand acquaintance with the particular land under consideration. With a national estate including country ranging from salt-incrusted deserts to valleys knee-deep with nutritious grasses or giant forests almost impenetrable because of luxuriant undergrowth, no general statutes

that may be enacted can be made so definite as not to require the exercise of well-informed judgment in their execution. To this end examination and classification of the public lands constitute an initial step in their disposition for development and settlement. That a few decades ago settlement and development commonly outstripped classification and often far preceded even the legal disposition of the land itself is no good reason for failure to follow the more logical procedure now.

The principle of land classification is inherent in many of the public-land laws, and classification of lands has in late years been specifically recognized by Congress as a step indispensable to the administration of the national domain. This public estate is even now so extensive and valuable as to demand a business policy. Making allowance for the alienated lands included within the land units described in the various coal-land areas withdrawn by executive order for classification, and also estimating the expected reduction of these withdrawals by classification of parts of them as noncoal land, the people of the United States possess to-day 44,000,000 acres of coal lands, exclusive of the Alaskan coal fields. A large proportion of this acreage, however, is underlain by the lower-grade coals. In the almost equally important items of oil and phosphate rock the existing withdrawals indicate national ownership of over 2,000,000 acres of oil and gas lands and nearly 3,000,000 acres of lands which will furnish our agricultural regions their future supply of mineral phosphate. Nor have all the agricultural lands been alienated. Public and private irrigation projects will reclaim several millions of acres of arid land, and dry farming under the enlarged-homestead act will materially add to the area of farm lands.

To insure appropriate disposition and to secure highest use of the Nation's lands, scientific land classification by the United States Geological Survey has been made an integral part of public-land administration. Quantitative knowledge of the land and its resources is now made a preliminary, first, to disposition of lands under the various settlement and development laws; second, to reservation of lands from present acquisition pending the enactment of adequate legislation; and third, to valuation of lands under a statute which provides for their disposition at prices expressing known value.

The purpose of land classification, then, is highest utilization, and to attain this end it has been necessary to coordinate the work of scientific investigation with the administrative functions of the Department of the Interior. The large participation of the Geological Survey in the public-land administration has naturally presented problems involving changes both in office and field organization and in executive and scientific methods. For these changes

there has been little or no precedent. Scientists and public men of older countries have been outspoken in their interest in this new application of science to governmental administration, and requests have been made for more detailed information on the subject than is available in the references appearing in administrative reports of the Secretary of the Interior and his subordinates.

A new application of any branch of science necessarily affects the science itself. New use involves added requirements and in turn may contribute in by-products even more than it demands. The general effect of this direct application of the Geological Survey's investigative work to large problems of public administration is believed to have been beneficial to science itself. It has broadened the outlook of the investigator, but especially it has demanded that results be sought which are quantitatively exact as well as qualitatively true.

A full statement of the policy of land classification and a detailed description of the procedure and methods so far found necessary to carry out that policy, in the stage of development already reached, are presented in this bulletin. This information is believed to be of value both to students of government and to geologists and engineers interested in the application of scientific investigation to practical business. The historical and legal phases of the discussion may be of greatest interest to the citizen concerned in his country's highest development, while the description of field methods should be of immediate value in indicating new requirements imposed upon scientific education, for details of this business policy of the Government are already being adopted in private and corporate land examinations.

This bulletin represents contributions by many authors—members of the land-classification board and of the field branches of the Survey. The description of the development of the Survey's organization for land classification, which immediately follows this introduction, was written by W. C. Mendenhall, who as chief of the land-classification board has been directly responsible for the preparation of the bulletin. The discussion of the history and legal basis of classification was prepared by M. W. Ball, a geologist who has been identified with the work of land classification from its beginning and is now chairman of the oil section of the board.

The chapter on the classification and valuation of coal land was written by G. H. Ashley, until recently State geologist of Tennessee and now the chairman of the coal section of the land-classification board. At the time of his earlier connection with the Survey Mr. Ashley, who has made a special study of coal problems in both the eastern and the western fields of the United States, wrote the chapter on "The value of coal land" which appears in Survey Bulletin 424. In the preparation of the present paper Mr. Ashley has been most

efficiently assisted by C. E. Lesher, who is independently responsible for the short section on "The preparation of data for classification." Mr. Lesher should be credited with many of the office methods which facilitate the prompt and accurate handling of data contributed by the field men of the Survey.

Field methods are discussed by E. G. Woodruff, C. H. Wegemann, R. W. Richards, and F. R. Clark, all of whom are members of the geologic branch and have had wide experience in field work leading up to land classification. Under the topic "Oil and gas lands," J. D. Northrop, who has had experience in the California oil fields, and C. H. Wegemann, a geologist of broad experience in the Rocky Mountain fields, have collaborated in the discussion of the geologic occurrence of oil and gas, while Mr. Northrop has contributed the section on classification. In a similar way, under "Phosphate lands," A. R. Schultz and R. W. Richards, the former the chairman of the phosphate section in the land-classification board and the latter a geologist who has worked out with great thoroughness and detail the complicated structural problems of the phosphate fields in southeastern Idaho and adjacent parts of Wyoming, have collaborated in the general discussion of phosphate problems, Mr. Schultz being responsible for the section on classification. The description of potash-bearing lands and their classification is the joint contribution of A. R. Schultz and H. S. Gale, Mr. Gale being the geologist in charge of the section of nonmetalliferous deposits of the geologic branch. E. H. Finch, of the land-classification board, who has been closely identified with the cooperative work between the Survey and the General Land Office, has contributed the section on "Miscellaneous nonmetalliferous lands," and F. C. Calkins, one of the experienced economic geologists of the Survey, who has had much to do with the classification of the lands in the Northern Pacific grant, has written the discussion of metalliferous mineral lands and the problems involved in their classification. The section on "By-products of mineral-land classification" was written by G. S. Rogers, a geologist of the geologic branch, whose recent work has been done in the western coal fields.

The discussion of classification in relation to water resources has been prepared under the direction of N. C. Grover, chief engineer of the land-classification board, M. O. Leighton, Herman Stabler, E. C. La Rue, and W. B. Heroy collaborating. Messrs. Grover, Stabler, and Heroy have prepared the sections relating to classification and office procedure, while Mr. Leighton, as chief of the water-resources branch of the Survey, and Mr. La Rue, one of the experienced field engineers of that branch, have cooperated in preparing the discussion of field methods.

It is noteworthy that the authors of the sections of this publication describing the procedure employed in the work have themselves originated for the most part the methods that are so essential to successful and authoritative land classification. Mention should also be made here, however, of the important part played by A. C. Veatch, the chairman of the land-classification board at the time of its organization, by C. Willard Hayes and Waldemar Lindgren, former chief geologists of the Survey, and by M. R. Campbell, who has been in charge of the geologic work in the western coal fields continuously since 1900 and has supervised the preparation of the sections on geologic field methods in this bulletin.

DEVELOPMENT OF THE SURVEY'S ORGANIZATION FOR LAND CLASSIFICATION.

The report of the committee of the National Academy of Sciences on the surveys of the Territories, prepared in accordance with the terms of a clause in the sundry civil bill approved June 30, 1878 (20 Stat., 206, 230), contains these statements indicating the opinion of the committee as to the land-classification functions of the bureaus whose organization its members were recommending:

> The best interests of the public domain require, for the purposes of intelligent administration, a thorough knowledge of its geologic structure, natural resources, and products. The domain embraces a vast mineral wealth in its soils, metals, salines, stones, clays, etc. To meet the requirements of existing laws in the disposition of the agricultural, mineral, pastoral, timber, desert, and swamp lands, a thorough investigation and classification of the acreage of the public domain is imperatively demanded. * * *
>
> The Land Office shall also call upon the United States Geological Survey for all information as to the value and classification of lands. * * *
>
> The publications of the Geological Survey should consist of an annual report of operations, geological and economic maps illustrating the resources and classification of the lands, reports upon general and economic geology in all its branches, with the necessarily connected paleontology.

Maj. J. W. Powell, reporting to the Secretary of the Interior on November 1, 1878, in response to the request of the acting president of the National Academy of Sciences to transmit any information available in the Department of the Interior as to surveys then in existence, after listing the classes of lands recognized under the laws, adds the following comment:

> An examination of the laws * * * will show that the classes of lands mentioned above are therein recognized, and in the administration of the laws relating to these lands those belonging to each specific class must be determined; but no adequate provision is made for securing an accurate classification, and to a large extent the laws are inoperative or practically void; for example, coal lands should be sold at $10 or $20 per acre, but, the department having no means of determining what lands belong to this class, titles to coal lands are usually obtained under the provisions of statutes that relate to lands

of other classes—that is, by purchasing at $1.25 per acre, or by homestead or preemption entry. An examination of the laws will exhibit this fact—that for the classification contemplated therein a thorough survey is necessary, embracing the geological and physical characteristics of the entire public domain.

After extended hearings before the House and Senate committees and the publication of many documents bearing upon the questions involved, Congress, in March, 1879, agreed upon a law which embodied the recommendations of the Academy of Sciences for the abolition of the Territorial surveys and the establishment of the United States Geological Survey but made no provision for the mensuration survey also recommended by the Academy.

Under the law approved March 3, 1879 (20 Stat., 377, 394), establishing the office of Director of the Geological Survey, it is provided—

> That this officer shall have the direction of the geological survey and the classification of the public lands and examination of the geological structure, mineral resources, and products of the national domain.

Clarence King, the first Director, who entered upon his duties May 24, 1879, discusses the functions of the then newly created organization in his first annual report to the Secretary of the Interior dated November 1, 1880. In this discussion he states that—

> Two special and distinct branches of duty are imposed upon the Director of the Geological Survey—(1) the classification of the public land and (2) the examination of the geological structure and mineral resources.
>
> As regards the classification of the public lands, the text of the law leaves an uncertainty whether this classification is intended to be a scientific exposition of the kinds of lands embraced in the national domain, such as arable, irrigable, timber, desert, mineral, coal, iron, showing the practical values and adaptabilities of the various classes or kinds of soil and surface, or whether, on the other hand, it was intended to furnish a basis of classification upon which the Government should part title to portions of the public domain. • • •
>
> Upon examination of the existing land system, I have assumed that Congress, in directing me to make a classification of the public lands, could not have intended to supersede the machinery of the Land Office and substitute a classification to be executed by another bureau of the Government without having distinctly provided for the necessary changes within the Land Office and adjustment of relations between the two bureaus. • • •
>
> I have therefore concluded that the intention of Congress was to begin a rigid scientific classification of the lands of the national domain, not for purposes of aiding the machinery of the General Land Office by furnishing a basis of sale, but for the general information of the people of the country, and to produce a series of land maps which should show all those features upon which intelligent agriculturists, miners, engineers, and timbermen might hereafter base their operations, and which would obviously be of the highest value for all students of the political economy and resources of the United States. Studies of this sort, entirely aside from the administration of the Land Office, can be made of the highest practical value; and to this end a careful beginning has been made.

This interpretation by Director King of the duties imposed upon the new bureau by that clause in the organic act charging him with responsibility for the classification of the public lands prevailed in part until about 1906, when the pressing need of the Department of the Interior for an adequate classification of mineral lands for purposes of administration led to a revival of this suspended function of the Geological Survey, not, as Director King seemed to think necessary, by superseding the machinery of the General Land Office, but by cooperation, financial and administrative, between that bureau and the Survey and by a series of orders from the Secretary of the Interior, to whom both bureaus report. These orders so define the part that each is to bear in public-land administration as to make the Survey chiefly responsible for the physical classifications.

At first the work was concentrated largely on the classification and valuation of coal land, and this phase continues to be quantitatively the most important. In the Twenty-eighth Annual Report of the Survey, for the fiscal year ended June 30, 1907, in discussing the work on the coal lands Director Smith makes this statement:

> Special investigations were conducted last year to determine the extent of the coal lands remaining in the possession of the Government and the quality and value of the coal deposits on these public lands. This work will be continued on a larger scale and under a more comprehensive plan. Special attention will be given to the classification and valuation of the coal lands and their prompt segregation from the noncoal lands. This work is to be provided for by a joint allotment from the appropriations for the geologic and topographic surveys and that for testing coals belonging to the Government, and the General Land Office is also cooperating.

The Twenty-ninth Annual Report of the Survey, for the fiscal year ended June 30, 1908, includes with some matter on the special features of the work of the Survey a discussion of land classification, which contains the following statement:

> In the last few years the Geological Survey has broadened the scope of its work in the classification of the mineral lands of the public domain. At the time of the organization of the Survey the classification intended by Congress was believed to be general in character and such as could be expressed on maps issued for the general information of the people. The present interpretation of the law is that the classification should be more definite, and therefore, during the last year, the Survey has continued its special field surveys of the coal lands belonging to the Government. • • •
>
> Increased demands have also been made on the mining geologists of the Survey for assistance in determining the mineral or nonmineral character of land for which title from the Government is sought.

This work, which has become an increasingly important feature of the Survey's activities, was definitely recognized by the organization, in December, 1908, of a land-classification board as a section of the geologic branch, and by the reorganization of the board on May 1, 1912, into a branch coordinate in rank with the other Survey branches.

The Geological Survey has been in existence as a distinct organization for about 34 years. The organizations which it succeeded and whose functions it continued to perform and gradually to enlarge upon as new duties were given it by Congress collected engineering material that was epitomized in topographic maps and geologic material that appeared either as geologic maps, as reports on geologic problems, or as data on the mineral resources of the Territories. Early in the Survey's history the necessities of its geologic work required the organization of a topographic branch for the preparation of base maps. Although these maps were intended to serve primarily as bases on which to delineate and present geologic material, they have proved to be of great value for other and wider uses. Not the least of these uses is that to which they are put in land classification. The thousands of maps issued are graphic engineering reports on the physical and cultural features of the areas they represent. They are essential to the study of drainage areas, irrigability of lands, possible power development, and rights of way, and supplemental sheets now prepared give additional data on the distribution of timber and of springs, of desert and of grass land, and of cultivated and irrigated areas.

On March 20, 1888, Congress, by joint resolution, directed the Secretary of the Interior, through the United States Geological Survey, to make a special investigation of the practicability of constructing reservoirs for the storage of water in the arid regions of the United States. This work was supported for a time by appropriations but was later discontinued by Congress after many reservoir sites had been examined and segregated and a number of reports valuable in the classification of the lands of the arid regions had been published.

After the irrigation survey was abolished the division of hydrography was organized within the Geological Survey, at first as a part of the topographic branch and later with special small appropriations, its purpose being to continue that part of the work of the irrigation survey that involved the study of the available water resources of the Western States and Territories. As the value of this work to reclamation became manifest, Congress responded by increasing the amount of the funds annually available for this purpose until in 1903 they reached the sum of $200,000 a year.

On June 17, 1902, the reclamation act (32 Stat., 388) was passed. This act represented the culmination toward which the work of the division of hydrography had up to that time been tending. That work gave definite information as to available supplies of water and the lands on which the water could be used. The reclamation act authorized the construction of works for the application of these waters and the reclamation of the tributary lands. But the reclamation fund is not available for general studies of water supplies; it can

be used only for studies of water available for use on specific projects. The work of the division of hydrography therefore did not cease with the organization of the Reclamation Service but has been continued in the Geological Survey by the water-resources branch.

Developments within the geologic branch since its organization have likewise marked a steady evolution from its original type. The branch has grown, its appropriations and its force have increased, and its work has been more closely subdivided and specialized and has attained greater refinement in all departments; and while this evolution has been taking place it has steadily accumulated a great mass of facts bearing on the geology and mineral resources of the United States.

The material accumulated since their organization by the field branches of the Survey—the geologic branch, the topographic branch, the water-resources branch and its predecessors, the irrigation survey and the division of hydrography—constitutes a vast body of information concerning the public domain—its geology, its geography, and its water supplies and the engineering features that control the distribution of these supplies. This store of information is by no means complete, for many problems are still untouched and many areas are unexamined, but nevertheless the archives of the bureau contain a greater mass of material of the kind required for classifying the remaining lands of the public domain into types that accord with their various uses than exists anywhere else in the public records.

With the accumulation of the data indicated the Department of the Interior and its bureaus have become increasingly ready and willing to call on the Survey for assistance in that phase of public-land administration which requires as its basis a classification of the lands into the types recognized in the statutes.

The requests made by the department for information contained in the Survey's records were at first sporadic; later they became more frequent and numerous, so that it became necessary to create within the Survey itself an organization to assemble this information systematically and transmit it to the department and to other bureaus in the department in such form as would be most readily applicable to the solution of administrative problems. This organization was named the land-classification board and was first formed as a section of the geologic branch and finally made a branch of the Survey coordinate in functions and responsibility with the field branches whose evolution has been briefly outlined.

The Survey's organization for classifying the public lands consists, then, fundamentally and primarily, of three field branches—geologic, topographic, and water resources—and finally of the recently organized office branch known as the land-classification board,

with its staff of geologists and engineers, who analyze and translate into terms of public-land administration the data collected by the geologists and engineers of the field branches.

In its organization the land-classification board is in a sense a replica in miniature of the bureau of which it is a part. It consists of two divisions—a division of mineral classification and a division of hydrographic classification. The first corresponds to the geologic branch and receives, digests, and issues as land-classification data the material collected by the field geologists; the second bears a corresponding relation to the topographic and water-resources branches and similarly utilizes the engineering data gathered by the field force of those branches. Again, the division of mineral classification contains a number of sections which correspond closely with similar sections in the geologic branch. These sections, in the organization as it exists at present, are the coal section, the oil section, the phosphate section, and the metalliferous section, corresponding roughly to similar sections in the geologic branch as well as to the principal of the natural resources with which the board deals.

The work of the coal section, described elsewhere in detail, is to define the principles that shall control coal-land classification, to determine the character of the data necessary for this purpose, to receive these data as collected by the field geologists of the geologic branch, and to make and promulgate the classifications and valuations by the use of these data—this in accordance with principles already carefully defined. The coal section consists of a chairman, who is a member of the land-classification board and one of the most experienced coal geologists of the Survey, and a number of additional members, who are familiar with coal problems and are chosen usually from the geologic branch, although some have been chosen from other sections of the board. The coal section thus organized holds frequent sessions, which are attended by coal geologists who have data to present for consideration. At these sessions the problems that have arisen in the field are discussed and solved in accordance with the established rules of the board. The form and the procedure for the submission of data, including data for classification and valuation, are prescribed, and after these data are received appropriate recommendations are made to the Director for withdrawals or restorations, and valuation plats are prepared for his approval and for promulgation by the Commissioner of the General Land Office.

Each step of these various processes is carefully recorded, in order that all evidence considered and all action taken may readily be reviewed at any future time should questions arise as to the correctness of the action or should new evidence be presented. Thereafter when reports on any subdivision classified are called for by any

Government department, by other bureaus, by public officials, or by citizens, prompt response can be made in the light of all action theretofore taken affecting that subdivision.

Because the laws applicable to coal lands, unlike those providing for the disposal of lands containing other minerals, authorize not merely the classification of the public domain as coal or noncoal land but the valuation and sale of the coal land at prices to be fixed in accordance with the quantity, quality, and accessibility of the coal, more complete action is possible in dealing with coal lands than with others, and the very completeness of action required involves correspondingly difficult problems.

Similar sections have been organized within the division of mineral classification for dealing with lands that may contain oil and gas, phosphate, and other nonmetalliferous minerals and for such limited and special classifications of metalliferous land as are required by law. The organization of each of these sections is similar to that of the coal section, and the action taken by them follows similar lines. Members of the land-classification board act as chairmen of the oil and gas section, the phosphate section, and the metalliferous section. Other members of the sections are selected from geologists who are engaged in field work on the particular resource which is the subject matter of the board's action.

A similar but less formal organization has been effected for the division of hydrographic classification. This division deals with those phases of land classification that depend on water supply and that involve the solution of engineering problems. The division's chief task is the classification of lands according to their irrigability and their power value, but it also reports on various complex problems which are involved in the consideration of miscellaneous rights of way. This division is administered by the chief engineer of the board. As occasion may demand, sections are organized within it for disposing of the various problems that arise. At present (1918) there are two such sections, one dealing with water powers and the other with irrigation. Each section consists of a chairman and two or more additional members, usually chosen from the engineers or hydrographic geologists of the water-resources branch. The section thus constitutes a committee which, like the sections in the division of mineral classification, may give preliminary consideration to a problem of classification (under the enlarged-homestead act, for example), or it may prepare instructions for the guidance of the field engineer or geologist and later give consideration to the data that he has obtained and prepare appropriate recommendations. The field branch with which these sections necessarily maintain closest relations is the water-resources branch, although their relation with

the topographic branch is but little less close. The graphic data on drainage areas, stream grades, reservoir sites, and general topographic features which result from the work of the topographic branch, when combined with the data on water supply assembled by the water-resources branch, furnish the basis for determining most irrigation and power problems.

In addition to the work done by these technical divisions and sections, certain miscellaneous duties are performed by means of a less well-defined administrative division of the board, whose functions are closely interwoven with those of the technical divisions and are participated in by some of the same officers. A committee, of which the secretary of the board is chairman, has charge of the filing and docketing system. The chairman of the oil section is responsible for the records in the division of mineral classification and for the details of cooperation with the Land Office and the Indian Office; the chairman of the water-power section is chiefly responsible for the records in the division of hydrographic classification.

The more important elements in the organization are set forth in the following outline:

LAND-CLASSIFICATION BOARD.

Administration.

Chief of board.
Chief engineer.
Secretary.

Division of mineral classification.

A geologist in charge.
Coal section.
Oil section.
Phosphate section.
Metalliferous section.

Division of hydrographic classification.

A chief engineer in charge.
Water-power section.
Irrigation section.

HISTORY AND LEGAL BASIS FOR LAND CLASSIFICATION.

INTRODUCTION.

Ever since the policy of selling the lands of the public domain as a source of national revenue was abandoned and the contrary policy of so disposing of them as to promote settlement and development was adopted, the administration of the land laws passed by Congress

has required a segregation of the lands into classes according with their character. It is apparent, although it has nowhere been expressly stated by Congress, that the fundamental principle guiding that body has been to dispose of each tract of the public domain for the use to which it is best adapted. Thus the laws have provided that agricultural entry should not be made upon valuable mineral lands, that lands containing deposits of coal should be sold only as coal lands, and so on for all other classes of lands. The underlying theory of devoting the public lands to their highest use and the consequent necessity for classification of uses may easily be recognized from a study of the brief outline of the more important existing land laws given on pages 20–32.

The same recognition by Congress of the necessity for land classification is shown by numerous acts calling for the classification of specific areas. Nearly every law providing for the opening of an Indian reservation has required the lands to be classified preliminary to their disposition. The act of February 20, 1895 (28 Stat., 683), provides and appropriates for a definite classification of lands within the limits of the Northern Pacific Railroad grant in portions of Montana and Idaho, and the sundry civil bill of June 25, 1910 (36 Stat., 739), makes further appropriation for the same purpose. The act of October 2, 1888 (25 Stat., 526), makes provision for a classification that was not necessary to the administration of the land laws then in force by appropriating $100,000 to the Geological Survey "for the purpose of investigating the extent to which the arid region of the United States can be redeemed by irrigation and the segregation of the irrigable lands in such arid region and for the selection of sites for reservoirs and other hydraulic works necessary for the storage and utilization of water for irrigation and the prevention of floods and overflows."

A relatively recent indication of Congressional belief in land classification is afforded by the two acts of June 25, 1910, providing for the withdrawal of lands from entry, the one of public lands, the other of lands in Indian reservations. As withdrawals constitute one step in the process of classifying the public domain, the passage of bills authorizing withdrawals clearly reaffirms the established policy of land classification. One of these acts (36 Stat., 847), in terms sanctions the classification of lands, providing—

> That the President may at any time, in his discretion, temporarily withdraw from settlement, location, sale, or entry any of the public lands of the United States, including the District of Alaska, and reserve the same for water-power sites, irrigation, classification of lands, or other public purposes to be specified in the orders of withdrawals, and such withdrawals or reservations shall remain in force until revoked by him or by an act of Congress.

The other (36 Stat., 855) provides—

That the Secretary of the Interior be, and he is hereby, authorized, in his discretion, to reserve from location, entry, sale, allotment, or other appropriation any lands within any Indian reservation, valuable for power or reservoir sites, or which may be necessary for use in connection with any irrigation project heretofore or hereafter to be authorized by Congress.

Thus the plain intention of Congress that the public lands shall be classified and that they shall be disposed of in accordance with their classification is shown by definite provisions for the classification of certain areas, by the authorization of land withdrawals, and by the creation of an organization—the Geological Survey—among whose prescribed duties the classification of the public lands is specifically stated. But were there none of these evidences the fact that Congress has consistently recognized the necessity for the classification of public lands would be established beyond question by a study of the land laws, which, as the following brief outline will show, could not be administered without some sort of segregation into classes. This outline does not purport to set forth in detail all the laws under which disposition is made of the public lands; it only sketches the principal features of the more important laws.

LAND LAWS.

GENERAL DIVISIONS.

The land laws of the United States may be divided into two distinct classes—public-land laws and land grants. The first are general laws providing for the disposition of lands to any duly qualified person who may wish to avail himself of the prescribed conditions; the second are special laws granting certain areas to specified individuals, corporations, or State governments. The laws of each of these two classes may in turn be subdivided, the public-land laws falling loosely under the headings of agricultural, mineral, and coal land laws and laws relating to public and quasi-public uses, whereas land grants may be divided into grants made to States and grants made to railroads.

PUBLIC-LAND LAWS.

AGRICULTURAL-LAND LAWS.

Purpose.—In general, the purpose of the laws relating to agricultural land is to promote the settlement of the public domain. The principal acts are those providing for homesteads, forest homesteads, enlarged homesteads, desert-land entries, entries under the reclamation act, the sale of isolated tracts, and timber and stone entries. Every tract of land to which these laws are applied must be nonmineral in character.

Homesteads.—The homestead act was passed by Congress in 1862 and was approved by President Lincoln on May 20 of that year (Rev. Stat., 2289–2303). It marked the final abandonment of the policy of disposing of the national domain as a means of providing public revenue. Until 1912 the homesteader was required to establish a residence on his land and to reside thereupon for a period of five years. No definite amount of cultivation was required, but the building of houses and barns and the cultivation of a part or all of the area were regarded as evidence of the good faith of the entryman in entering the land for the purpose of building a home for himself, this being the fundamental object of the homestead act. On June 6, 1912 (37 Stat., 123), the law was amended by reducing the five years' residence theretofore required to a residence of three years. The requirement as to residence is modified by what is known as the "commutation clause" (Rev. Stat., 2301, as amended by the act of March 3, 1891, 26 Stat., 1098), which provides that after 14 months' residence and cultivation title may be obtained by paying a fixed price per acre, this price being either $2.50 or $1.25, the first if the land is within, the second if it is without the limits of a railroad grant. Homesteads reserving coal or oil and gas to the Government under the acts of June 22, 1910 (36 Stat., 583), and August 24, 1912 (37 Stat., 496), described later (p. 45), may not be commuted. The amendment of June 6, 1912, also provides that the entryman must cultivate "not less than one-sixteenth of the area of his entry beginning with the second year of the entry and not less than one-eighth beginning with the third year of the entry and until final proof." The homestead act contains the clause "nor shall any mineral lands be liable to entry and settlement." The area of the homestead is restricted to 160 acres.

Forest homesteads.—Lands in national forests are not in general open to agricultural entry, but under the act of June 11, 1906 (34 Stat., 233), forest-reserve lands which are chiefly valuable for agriculture, which are not needed for public purposes, and which, in the opinion of the Secretary of Agriculture, may be occupied without injury to the forest, may be entered under the homestead laws. Application for a particular tract desired, which must not exceed 160 acres in area nor 1 mile in length, must be made to the Secretary of Agriculture. The land is then examined by a field agent of the Forest Service, and if his report is favorable the land is listed to the Department of the Interior, where homestead entry is allowed. The entry thereafter proceeds as would any other entry under the homestead law, but no commutation is permitted. The law differs from all other agricultural-land laws in that the land must be chiefly valuable for agriculture and that the entry may be described by metes and bounds instead of by legal subdivisions of the public-land survey.

Enlarged homesteads.—An act known as the enlarged-homestead act, approved February 19, 1909 (35 Stat., 639), provides that in the States of Colorado, Montana, Nevada, Oregon, Utah, Washington, Wyoming, Arizona, and New Mexico a homestead entry may comprise 320 acres of nonmineral lands which have been designated by the Secretary of the Interior as not susceptible of successful irrigation at a reasonable cost from any known source of water supply. On June 17, 1910 (36 Stat., 531), a similar act was approved applying to Idaho, and on June 13, 1912 (37 Stat., 132), one applying to California and North Dakota. The requirements as to residence and cultivation on an "enlarged homestead" are, under the act of June 6, 1912 (37 Stat., 123), the same as those for other homesteads, but enlarged-homestead entries may not be commuted by cash payment. The enlarged-homestead acts further provide that tracts in the States of Utah and Idaho which have not upon them "such a sufficient supply of water suitable for domestic purposes as would make continuous residence upon the lands possible" may be subject to entry without the necessity of residence, but one-eighth of the area of the entry must be cultivated from the beginning of the second year and not less than one-fourth from the beginning of the third year until final proof has been submitted.

Desert land.—Under the desert-land acts entry may be made on lands which, by reason of lack of rainfall, will not produce native hay or other agricultural crops or trees without irrigation. Such lands may be entered by irrigating and producing crops on not less than one-eighth of the area. No residence is required. Any person duly qualified may enter an area not exceeding 320 acres of such lands. It should be noted, however, that this 320-acre area is limited by the fact that one person is not permitted to acquire more than 320 acres of land under the public-land laws, mineral entries not being taken into account. The entryman is given three years in which to reclaim his land, which must be nonmineral in character.

Reclamation act.—Under the act of June 17, 1902 (32 Stat., 388), the Government is building great irrigation projects for the reclamation of arid and semiarid lands in the West. Lands thus reclaimed, which must be nonmineral in character, may be entered by any person qualified to make a homestead entry. The enterable area is not more than 160 acres but is different in the different projects and in different parts of the same project. No charge is made for the land, but the entryman must pay his proportional part of the cost of the project in ten yearly installments. Three years' residence on the land is required, as under other homestead laws, and at least one-half the area of the entry must be cultivated before title can be obtained.

Isolated tracts.—Small tracts of public land surrounded by lands which have already been entered may be purchased as isolated tracts

under section 2455 of the Revised Statutes as amended by the act of June 27, 1906 (34 Stat., 517). Under the act of March 28, 1912 (37 Stat., 77), mountainous tracts which are not isolated by entered land but which are unfit for cultivation may be purchased by the owner of adjoining land in the same manner as isolated tracts. A person desiring to purchase land in this manner files with the local land officers an application to purchase, whereupon, if the lands are nonmineral and are in fact isolated or mountainous, a public sale is advertised, at which the lands are sold to the highest bidder. No residence or cultivation is necessary, but the land must be nonmineral.

Timber and stone lands.—The foregoing five classes of laws constitute the principal types under which agricultural entry may be made. There remains a sixth class of considerable importance, which, while applying only to lands more valuable for other purposes than for agriculture, is nevertheless more nearly allied to the agricultural laws than to the laws relating to minerals, coal, or quasi-public uses. Under the act of June 3, 1878 (20 Stat., 89), and acts amendatory thereof nonmineral lands which are valuable chiefly for the timber and stone thereon and which are unfit for cultivation may be appraised and sold at not less than $2.50 per acre. Application to purchase is made in a manner similar to that required by the laws relating to isolated tracts, but there is no public sale. There is instead an appraisement of the value of the land by an appraiser designated by the Government, and the lands are purchased at the price so fixed.

MINERAL-LAND LAWS.

General provisions.—The mineral-land laws were in the main formulated in the 10 years between 1865 and 1875. They are based largely on local mining customs which had attained the force of law in the mining camps on the public domain. Their constant purpose has been to promote mineral development. The act of May 10, 1872 (Rev. Stat., 2319), provides that "all valuable mineral deposits in lands belonging to the United States, both surveyed and unsurveyed, are hereby declared to be free and open to exploration and purchase, * * * by citizens of the United States and those who have declared their intention to become such." No important amendment of the mining laws has been made since the date of this act. At that time the known deposits of importance on the public domain comprised only metalliferous minerals, and the laws were framed with such deposits in mind, provision being made for two classes of claims—lode and placer. From time to time since the adoption of the mining laws one and another nonmetalliferous mineral has become important, and its entry under the placer law has been authorized by Congress, which has thus specially provided for the entry of lands that are chiefly valuable for petroleum, saline, and building stone.

The general procedure under the mineral-land laws is the same for all classes of deposits. The person who desires to obtain mineral lands must first make a discovery of valuable mineral within the limits of the claim that he wishes to locate. This discovery, as interpreted by the Department of the Interior and the courts, must be such a showing of mineral as would warrant a man of ordinary prudence in expending his time and labor upon the claim in the reasonable hope and expectation of developing a paying mine thereon, or, as expressed in one of the latest decisions (40 L. D., 271) interpreting the lode law, "there must be actually physically exposed" within the limits of the claim "a vein or lode of mineral-bearing rock in place, possessing in and of itself a present or prospective value for mining purposes." The method of location, the posting of location notices, and other similar matters are determined by the local customs or miners' rules of the district in which the claim is situated. In order to hold a claim against possible adverse claimants—in other words, to prevent its being jumped—at least $100 worth of work, called "assessment work," must be performed on it each year. After $500 worth of assessment work has been done and certain requirements as to recording and surveys have been met, the applicant, on payment of a fixed price per acre, is entitled to patent.

Lodes.—Claims for veins of quartz or other rock in place are known as lode claims (Rev. Stat., 2320). Their size is governed by the rules of the mining district in which they are situated but must not exceed 600 feet in width and 1,500 feet in length. Claims need not conform to the public-land system of surveys and may be in almost any shape, provided only that the end lines of each claim shall be parallel to one another. When patent is sought, a purchase price of $5 an acre must be paid.

All veins that come to the surface within a given claim are the property of the owner of that claim through their entire depth (Rev. Stat., 2322) but only for such portion of their extent as lies between the end lines of the claim. Thus the owner of the outcrop or apex of a lode may follow it downward indefinitely so long as he stays within his end lines and may mine it without regard to the ownership of the land under which it passes. This provision, which is known as the "law of the apex," has unquestionably been more provocative of litigation than any other provision of American land law.

The lode law provides also for the discovery in driving tunnels of veins not outcropping on the surface and not previously known to exist. It grants to the discoverers the right to 1,500 feet of extent of each vein so discovered within 3,000 feet of the face of the tunnel, with the same apex right as if the discovery were made at the surface. Failure for six months to prosecute work on a tunnel acts

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as an abandonment of the right to veins which may subsequently be encountered.

The number of claims which may be entered by [illegible] under the lode law is unlimited, provided he does the necessary assessment work and otherwise complies with the law for each claim. Moreover, the owner of a group of claims may concentrate his assessment work on one claim of the group if such work tends to the development of every claim in the group.

Placers.—The placer law, which was approved July 9, 1870 (16 Stat., 217), was intended to apply to gold and silver distributed through deposits of sand and gravel. As at that date there were no known important mineral deposits except veins and placers, the law provides (Rev. Stat., 2329) that "placer" claims shall include "all forms of deposit, excepting veins of quartz or other rock in place." These placer claims are subject to entry and patent in a manner similar to lode claims, but where the lands have been surveyed the claim must conform to the legal subdivisions of the survey. The purchase price is $2.50 an acre. The maximum area that may be included in one claim by an individual is 20 acres, although, as in lode claims, there is no limit to the number of claims that may be entered. An association may enter in one claim an area equal to 20 acres for each member but not more than 160 acres. Only one discovery of mineral is required to support a placer location, whether it be of 20 acres by an individual or of 160 acres by an association. The applicant for a placer claim must make affidavit that there is not within the limits of the claim any valuable vein or lode and also that title is not sought in order to control watercourses or to obtain valuable timber. The assessment work on each claim, whether of 20 or 160 acres, must amount to $100 a year and to $500 before patent may be issued. On placer as on lode claims annual assessment work to the amount of $100 for each claim in a group may be done on any one of the claims in the group, provided it tends to the exploration or development of all.

Building stone.—By the act of August 4, 1892 (27 Stat., 348), the placer law was extended to apply to lands chiefly valuable for building stone. The requirements as to discovery, assessment work, area, and price are the same as for other placers. It is to be noted that in this act the factor of relative value was for the first time specifically introduced into mineral-land law. The earlier laws provide for mineral entry on lands which are valuable for their mineral deposits. It has been argued that only lands whose mineral value is greater than their agricultural value are properly enterable as mineral land, and the decisions of the department and the courts can not be said to have settled the matter conclusively. In the building-stone and

subsequent extensions of the placer law, however, it is specifically stated that the lands must be chiefly valuable for the mineral upon whose discovery the claim is based.

This extension of the placer law to cover building stone neither repealed nor conflicts with the timber and stone act of June 3, 1878 (20 Stat., 89), already discussed. Thus lands chiefly valuable for building stone may be purchased at an appraised value not less than $2.50 per acre or may be entered under the placer law and patented after the completion of the required amount of assessment work, on payment of $2.50 per acre.

Oil.—About a quarter of a century after the passage of the placer law valuable deposits of petroleum were discovered on public lands. The discoverers, finding themselves without an appropriate law under which to apply for a patent, made application under the placer law—not because it was fitted to the needs of the situation but because of its general provision that all forms of deposit excepting veins of quartz or other rock in place should be entered thereunder. The Department of the Interior, recognizing the undesirability of applying the placer law to oil and gas, refused to allow the applications. On an appeal to Congress for relief, the act of February 11, 1897 (29 Stat., 526), was passed, providing that lands chiefly valuable for petroleum and other mineral oils should be enterable under the placer law. On February 12, 1903 (32 Stat., 825), specific authority was granted for doing assessment work on any one of a group of oil claims lying contiguous and owned by the same person or corporation, not exceeding five claims in all, provided that such assessment work tends to develop or determine the oil-bearing character of all the claims. The requirement of discovery of valuable minerals as a prerequisite to location—a requirement reasonable enough when applied to veins outcropping at the surface or to gold placers—is applied as rigidly to deposits of oil and gas, which, as a rule, can be discovered only after long and expensive exploration, as to other minerals. Lands included in petroleum placers, like those entered for building stone, must be chiefly valuable for the purpose for which they are claimed.

Salines.—The act of January 31, 1901 (31 Stat., 745), extends the placer law to cover lands that contain salt springs or deposits of salt in any form and that are chiefly valuable therefor. This has been interpreted as including only sodium chloride, no specific provision having been made for other soluble salts. The requirements as to area, assessment work, and price are those contained in the original placer law, except that the same person may not locate or enter more than one claim. The consideration of relative worth is again introduced.

COAL-LAND LAWS

The law under which disposition is made of coal differs so radically from the laws regarding other minerals that it is not ordinarily classed with the mineral-land laws. It was approved March 3, 1873 (17 Stat., 607), and was incorporated into the Revised Statutes as sections 2347 to 2352. Any qualified person may purchase an area of coal land not exceeding 160 acres on payment of not less than $10 an acre if the land is more than 15 miles from a railroad and not less than $20 an acre if the land is within 15 miles of a railroad. An association of persons severally qualified may purchase 320 acres. An association of four or more persons who have opened and improved a coal mine upon the public lands and have expended not less than $5,000 in working and improving it may enter an area not exceeding 640 acres. No person may make more than one coal entry, either individually or as a member of an association, and no association any member of which has previously exhausted his coal right may purchase coal land. A person or association opening a mine on the public lands is entitled to a preference right of entry for the lands on which the mine is situated, provided that a "coal declaratory statement" is filed within 60 days from the initial date of actual possession and the commencement of improvements upon the land. This preference right is good for one year only. The operation of the law is restricted to surveyed lands, which must not be valuable for their content of gold, silver, or copper.

For over 30 years after the passage of this law all coal lands were sold at the minimum prices of $10 and $20 an acre prescribed by the statute. Since 1907 the selling prices have been fixed by the Geological Survey and have ranged from the minimum prices up to $600 an acre.

LAWS RELATING TO PUBLIC AND QUASI-PUBLIC USES

The laws governing public and quasi-public uses of land differ from the other laws under discussion in that they provide for the use of rights of way for various specified purposes and do not contemplate the transfer to the beneficiaries thereunder of fee title to the land affected.

Railroads.—By the act of March 3, 1875 (18 Stat., 482), Congress granted to railroad companies right of way to the extent of 100 feet on each side of the center line of a proposed railroad through the public lands, under prescribed conditions. Upon the approval by the Secretary of the Interior of the location map filed by any railroad company, the road as located is noted on the plats in the General and local land offices, and thereafter all public land over which such right of way passes is disposed of subject to such right of way. By act of March 2, 1899 (30 Stat., 990), Congress provided for similar

rights of way across Indian reservations, and by the act of March 3, 1899 (30 Stat., 1233), the Secretary of the Interior was authorized to approve rights of way for wagon road, railroad, or other highway across any forest reservation or reservoir site when in his judgment the public interest would not be injuriously affected thereby.

Irrigation.—By act of March 3, 1891 (26 Stat., 1095), Congress granted to canal and ditch companies formed for the purpose of irrigation the right of way for canals, ditches, and reservoirs to the extent of the ground occupied and 50 feet on each side of the marginal limits thereof, across public lands and reservations, provided that no such right of way shall be so located as to interfere with the proper occupation by the Government of any such reservation and that all maps of location shall be subject to the approval of the department of the Government having jurisdiction over such reservation. Upon the approval by the Secretary of the Interior of the location map the right of way is noted on the plats in the General and local land offices and thereafter all public land over which the right of way passes is disposed of subject to such right of way. By act of May 11, 1898 (30 Stat., 404), the use which may be made of the canals, ditches, and reservoirs for which right of way is secured under the act of 1891 was extended to include purposes of a public nature, water transportation, domestic purposes, and the development of power, as subsidiary to the main purpose of irrigation. The act of February 15, 1901 (31 Stat., 790), which provides for the issuance of revocable permits for the development of power, covers also canals, ditches, pipes and pipe lines, flumes, tunnels, or other water conduits and water plants, dams, and reservoirs used to promote irrigation.

Power.—Power development on the public lands and reservations can at this time (February, 1913) be accomplished only under the act of February 15, 1901 (31 Stat., 790), except that power development subsidiary to the main purpose of irrigation may be made under the irrigation acts and that power development on national forests for mining, milling, and municipal purposes may be made under the act of February 1, 1905 (33 Stat., 628). The act of February 15, 1901, authorizes the Secretary of the Interior to issue revocable permits, under general regulations to be fixed by him, for rights of way for electrical plants, poles, and lines for the generation and distribution of electrical power to the extent of the ground occupied by the works and not to exceed 50 feet on each side of the marginal limits thereof. The law provides that permits issued under this act shall not be held to confer any right, easement, or interest in, to, or over any public land, reservation, or park. The act of March 4, 1911 (36 Stat., 1253), authorizes the head of the department having jurisdiction over the lands to grant rights of way for a period not exceeding 50 years upon the public lands, national forests, and reservations for poles and lines for the transmission and distribution of electrical power, to the extent of 20 feet on each side of the center line.

Mining and milling.—The act of February 1, 1905 (33 Stat., 628), grants rights of way within or across national forests for dams, reservoirs, water plants, ditches, flumes, pipes, tunnels, and canals for mining purposes and for the purposes of the milling and reduction of ores. Outside of the national forests the use of similar rights of way for these purposes may be made only under revocable permit under the act of February 15, 1901.

Municipal uses.—Rights of way for municipal use for procuring water supply or for developing power may be obtained within a national forest under the act of February 1, 1905, and outside of the forests under the act of February 15, 1901.

LAND GRANTS.

GRANTS TO STATES.

In aid of schools and State institutions.—The Continental Congress, about the year 1785, declared that to each State created out of the public domain there should be given a certain portion of each township in the State, the proceeds derived therefrom to be used for public education. Accordingly, when the first State, Ohio, was admitted into the Union from the public domain, April 30, 1802 (2 Stat., 173), sec. 16 of each township was granted for the establishment of a school fund. As other States have been admitted this practice has been deviated from only in adding to the acreage granted. Sec. 16 has been a school section in every public-land State; to this sec. 36 has been added in many States, and in some States secs. 2, 32, and 36. The title of the State to these sections attaches immediately upon survey, unless the lands are at that date known to be mineral in character or are included in a valid settlement or other claim under the public-land laws or are within a forest, military, Indian, or other reservation. In any of these contingencies the State does not obtain title, but may select an equal area of nonmineral lands elsewhere. These are known as indemnity lands. As a rule they are not at once selected by the States but are selected only as the demand for specific lands arises.

In addition to granting school lands in place and their associated indemnity lands, Congress has made to certain States "quantity grants"—that is, grants of specified quantities of nonmineral lands wherever the State may choose to select them—in aid of State institutions, such, for example, as insane asylums. Selection rights under these grants, like those under the indemnity lists, are as a rule exer-

cised by a State only when individuals or corporations purchase the right to select certain desired lands.

In aid of internal improvements.—In the early days of the country's history the right of Congress to grant public lands in aid of internal improvements was bitterly contested. The first legislation of this character was contained in the enabling act of the State of Ohio, already cited, and provided that one-twentieth of the proceeds of the sale of public lands within the State should be given to the State to be used in establishing public roads. The first grant of specific lands in aid of internal improvements was not made until February 28, 1823 (3 Stat., 727). This grant also was made to the State of Ohio to aid in the construction of a wagon road. Since that time there have been ten other wagon-road grants, eight canal grants, three river-improvement grants, and twenty railroad grants. The railroad grants to States alone approximate 40,000,000 acres. No grant to a State in aid of internal improvements has been made since the grant to Oregon for the Coos Bay wagon road on March 3, 1869 (15 Stat., 340). Although these grants were in terms made to the States, most or all of them were in fact made through the States to corporations that carried out the improvements contemplated.

Carey Act.—The act of August 18, 1894 (28 Stat., 372, 422), commonly known as the Carey Act, and amendments thereto, the purpose of which is to aid the public-land States in the reclamation of the desert lands therein and in the settlement, cultivation, and sale of such lands in small tracts to actual settlers, authorize—

(*a*) The temporary withdrawal of public lands from settlement or entry pending investigation and survey preliminary to the filing of an application for segregation, such withdrawn lands to be restored to settlement and entry at the end of one year from the date of withdrawal in case application for segregation is not theretofore made.

(*b*) The segregation of public lands by the Secretary of the Interior, contracts between the United States and any beneficiary State, and the reclamation of such lands by beneficiary States within 10 years from the approval of the State's application (subject to an extension of 5 years).

(*c*) The patenting to any beneficiary State of any tract of reclaimed land when satisfactory proof is made that an ample supply of water to reclaim it is actually furnished.

Other important provisions of the Carey Act are in brief as follows:

Prior to segregation of lands or execution of contract between the United States and any State, such State shall file a proper application and present satisfactory plans for the reclamation of the lands. Lands that are not desert, lands that are occupied by bona fide settlers or under the mining laws, unsurveyed lands occupied with a view to entry under the desert-land laws, and lands containing valuable deposits of minerals other than coal are not subject to segregation. Coal lands (in Utah oil and gas lands also) may be segregated, but when patent is issued it must contain a reservation of these minerals to the United States.

The usual procedure under the Carey Act is about as follows:

A corporation or individual applies to the State for the withdrawal of certain public lands proposed for irrigation. The State thereupon submits to the Interior Department an application for their withdrawal. On the approval of this application the State is allowed one year in which to investigate the project and prepare satisfactory plans for reclamation. The proposing company conducts the investigations and if a project that is considered feasible is developed makes application to the State for the segregation of the irrigable lands and offers to contract with the State for their reclamation. The State thereupon applies to the Interior Department for the segregation of the lands under the terms of the Carey Act and its amendments. If the plan of irrigation is found to be feasible, the irrigation company responsible, and the available water supply adequate, the lands are segregated and the contract for their reclamation is entered into between the United States and the State. When the irrigation works are completed to the satisfaction of the Government, patent is issued to the State or to its assigns. The State receives payment for the lands from the settler, and the irrigation company, either directly or through the State, receives payment from each settler for his proportionate share of the irrigation works and water rights involved.

RAILROAD GRANTS.

As already indicated, most grants of public lands in aid of internal improvements have been made through the States. Eight grants, however, have been made by Congress directly to corporations, to encourage the building of railroads. Four of these grants, aggregating approximately 100,000,000 acres, were made to Federal corporations created by Congress for the purpose of building the roads subsidized, and four were made to State corporations. Of the four grants to State corporations, two were declared forfeited by Congress in 1874, the two remaining aggregating approximately 6,000,000 acres. The first of the grants made directly to corporations was the Pacific railroads bill of July 1, 1862 (12 Stat., 489), which provided for the building of the Union Pacific-Central Pacific line from Missouri River to the Pacific coast. This act granted to the railroad every alternate section for 20 miles on either side of the right of way. The Northern Pacific grant of July 2, 1864 (13 Stat., 365), conveyed every alternate

section for 40 miles on either side of the right of way. Neither of these grants contained restrictions as to the use to be made of the lands, but certain of the later grants required the lands to be sold only to actual settlers at prices not to exceed $2.50 an acre. The last of the railroad grants was made to the Texas Pacific Railroad Co. on March 3, 1871 (16 Stat., 573). Since that time Congress has consistently refused to grant lands, either to States or to corporations, in aid of internal improvements.

All the railroad grants were restricted to lands containing no minerals except coal and iron. These two were given to the railroads because of their use in the construction and operation of the roads. In certain cases the railroads were permitted to select other lands in lieu of those which, normally constituting a part of the grant, proved to be valuable for minerals other than coal and iron or to be included within Indian or military reservations or national forests or to have been covered by valid settlement. The right to make these lieu selections is usually sold by the railroads in the form of "scrip," which may be filed on any vacant unreserved nonmineral land.

NECESSITY FOR LAND CLASSIFICATION.

A study of the land laws shows the absolute necessity of some form of segregation of the lands into classes as a prerequisite to their disposition. Agricultural entry may not be made on lands containing valuable minerals, nor coal entry on lands containing gold, silver, or copper; lands included in desert entries or selected under the Carey Act must be desert lands; enlarged-homestead lands must not be susceptible of successful irrigation; placer claims must not be taken for their timber value or their control of watercourses; and lands included in building-stone, petroleum, or salt placers must be more valuable for those minerals than for any other purpose. So through the whole scheme of American land laws runs the necessity for determining the use for which each tract is best fitted.

No specific financial provision has ever been made for a systematic classification of the entire public domain into classes representing the highest use for each area. Such a scheme, with proper provision for revisions whenever necessitated by changing conditions or increased knowledge, would be of immense value in the administration of the public domain, and if it had been initiated when the major portion of the public-land laws were in process of formation it would have saved to the public natural resources of immense value. It can hardly be questioned that the National Academy of Sciences had in mind such a systematic classification of the entire public domain when it recommended the creation of the Geological Survey, but the

new organization when created was not supplied with the funds to carry forward a work of such magnitude. The classification of coal lands and the segregation of lands valuable for oil, gas, phosphate, potash, water power, and reservoir sites constitute a tardy and very meager attempt to meet the need for a universal classification.

In default of a classification of the entire national domain the land department early adopted the expedient of requiring a classification of each tract of land at the time of its disposition. These classifications in general originated from four sources—first, from the applicant for the land; second, from deputy surveyors; third, from members of the Land Office field service; and fourth, from the Geological Survey. It is the present purpose to discuss the first three types of classification somewhat briefly and the last in considerable detail, and to show the weight given to each type and the results.

AGENCIES AND METHODS OF CLASSIFICATION.

CLASSIFICATION BY AFFIDAVIT OF APPLICANT.

Nearly every applicant for public land is required to submit an affidavit that the land desired is of a character properly subject to the proposed entry or selection. Every applicant under the agricultural laws must set forth by his own oath and that of two witnesses that the lands are nonmineral in character. The State in selecting indemnity or "quantity grant" lands must make affidavit to their nonmineral character. Mineral applicants must state under oath the discovery of valuable minerals, and similar affidavits are required of most if not all applicants.

Less and less weight has been given in recent years to classifications so made. It has been found that the affidavits of interested parties, whether furnished by individuals or submitted by sovereign States, do not furnish a reliable basis for the disposition of public lands. Furthermore, the determination of the mineral or nonmineral character of a particular tract may be too difficult and too complex a problem for solution by other than a special trained expert. At present all agricultural entries except homestead and desert-land entries on unwithdrawn lands are classified as to mineral character and power-site or reservoir value either by examination on the ground by the Land Office field service or by the Geological Survey from information contained in its records or procured by special examination. Thus, although the affidavit of the applicant has not been abandoned, it is of little importance. Similarly mineral claims in national forests are subjected to examination before the applicant's affidavit of discovery is accepted, and all along the line classification by the entryman or selector is being replaced by classifications made by the Government.

CLASSIFICATION BY DEPUTY SURVEYORS.

The regulations for the survey of public lands require the deputy surveyor to note and report all occurrences of mineral. These requirements have varied from time to time. In certain periods the deputy surveyor has reported a somewhat detailed classification of the lands surveyed into first-class agricultural, second-class agricultural, grazing, mineral, timber, etc. At one time all lands reported by deputy surveyors to be mineral in character were withheld from agricultural entry, but the inaccuracy of the segregations and the magnitude of the areas involved led to a general order throwing all such lands open to all forms of entry. The only present result of a report by a deputy surveyor that land is mineral is to subject agricultural entries to a more careful scrutiny than would otherwise be made.

CLASSIFICATION BY LAND OFFICE FIELD SERVICE.

The General Land Office has a well-organized field service engaged in the examination of entries and selections of public lands. All agricultural entries or selections, including State selections and railroad lieu selections but excepting homestead and desert-land entries on unwithdrawn lands, are examined by this field service as to their mineral character and power-site or reservoir values, unless the Geological Survey is able from its records to make a classification of the lands. Formerly the reports of the members of the field service were accepted as final without review outside of the Land Office and the Secretary's office, and, as a result, some classifications by the Geological Survey were overruled by the Land Office. The resulting confusion led to the adoption of cooperative agreements between the two organizations, whereby the information gathered by each is made fully available to the other. The first of these agreements was entered into July 10, 1910. It has been replaced by a more comprehensive and more systematic agreement adopted March 5, 1912. Under this agreement all entries, selections, or applications except metalliferous mineral entries, coal applications, and homestead and desert entries on unwithdrawn lands are referred by the General Land Office to the Geological Survey. The Survey thereupon renders to the Land Office a report on each case, classifying the land involved. If the Survey classifies the land as having no mineral, power, or reservoir value, questions concerning these values are considered as settled and the case goes forward if it is otherwise regular. If in a given case the Survey reports that the lands are mineral or that they have power or reservoir value the applicant is given 60 days within which to prove that the land is not of the character claimed by the Geological Survey but that it is in fact of the character originally claimed by him. If he fails so to prove, his application is canceled.

If the Geological Survey reports that it has not sufficient information to make a definite classification it furnishes to the Land Office whatever data it may have, which are placed in the hands of a member of the field service for field investigation and report. The report rendered is forwarded to the Geological Survey for further consideration, and a classification based upon it and other facts at hand is reported to the General Land Office. Under this agreement the records of the Survey are enriched by the data gathered by the Land Office field service and, on the other hand, the great amount of valuable information regarding the public lands on file in the Survey is made available to the Land Office in its administration of the land laws.

CLASSIFICATION BY THE GEOLOGICAL SURVEY.

HISTORICAL SKETCH.

Although the act organizing the Geological Survey definitely imposed upon the Director the duty of classifying the public lands, it was many years before the records of the organization contained a sufficient fund of information to be of great use in public-land administration. During its first quarter of a century the Survey devoted its energies almost entirely to gathering scientific data regarding the whole of the United States, and only within the last six or seven years has the immense fund of information so gathered been applied in a systematic way to the solution of public-land problems. During the early period there were perhaps but two practical applications of the Survey's work to land classification. The result of the first application was the segregation of reservoir sites under the act of October 2, 1888 (25 Stat., 527), to which reference has already been made. Congress in 1891 restored all the lands that had been segregated under this act except the areas actually needed for the construction of reservoirs, which still remain segregated as reservoir sites and are not subject to entry. The second application was connected with the administration of the reclamation act by the Geological Survey. Many withdrawals of lands to be included in reclamation projects were made by the Survey prior to the separation from it of the Reclamation Service. With these two exceptions the Geological Survey devoted its energies to gathering data rather than to applying the data gathered to the classification of public lands until the year 1906. Since that date the Survey has been actively engaged in land-classification work. The cooperative agreement whereby certain types of information are made available to the Land Office in its administration of individual

entries and selections has already been described. In addition coal lands are being classified and valued as rapidly as the funds at the disposal of the Survey will permit, and oil, gas, phosphate, and potash lands and lands valuable for water-power and reservoir sites are being withdrawn from entry as rapidly as information regarding them is obtained. It is proposed to explain here briefly the history of the classification undertaken with respect to each of these resources.

COAL LANDS.

In the years 1905 and 1906 the general public began to realize that large areas of valuable coal lands in the West had been obtained from the Government by means of agricultural entries. The frauds thus perpetrated were so great as to shock the public mind and to call for some immediate action to prevent further similar looting. Accordingly the President, on June 29, 1906, directed the Secretary of the Interior to withdraw from entry all valuable coal lands. The Survey had previously been making special studies of certain western coal fields and its geologists had assisted in unearthing some of the coal frauds. It was therefore prepared to submit a list of lands which should be withdrawn from entry, and on July 26, 1906, the Acting Secretary of the Interior withdrew from all forms of entry all the lands on the list submitted by the Survey. Other lists for withdrawal were prepared by the Survey during the summer and fall of 1906, and one very excellent list was prepared by the Forest Service. These withdrawals, being intended to prevent acquisition of coal lands under agricultural entry, were made in such terms as to prevent all forms of entry. However, on December 17, 1906, the form of all outstanding orders of withdrawal was modified to apply to coal entries only, so that the withdrawn lands became again subject to agricultural entries but were not subject to coal entry. Thus fraudulent acquisition again became possible and was prevented only by the activity of the field service of the General Land Office. On the other hand, purchase of withdrawn lands as coal land became impossible until after classification and valuation. From time to time other withdrawals from coal entry were made until the spring of 1909, when many of the outstanding withdrawals were restored to their original form and made effective against all forms of entry. Soon thereafter Congress passed the withdrawal act of June 25, 1910 (36 Stat., 847), and since that date coal withdrawals have prohibited all forms of entry except entries on certain classes of land which are exempted from withdrawal by that act and agricultural entries for surface rights only. The policy throughout has been to withdraw all lands on which there is a reasonable probability of the occurrence of coal, to examine these lands as rapidly as the funds

available will permit, and on the information gathered to base classifications, the lands found to be noncoal land being restored to entry and those found to contain workable coal being appraised at prices not less than the minimum prices prescribed by the statute.

For a time the withdrawals worked great hardship. The greater part of the lands thus withheld were not good agricultural lands, but the total acreage suitable for agricultural development was large. The situation was finally relieved by the passage of three acts providing for agricultural entry upon lands withdrawn or classified as coal lands, the Government retaining title to the coal deposits and the right to prospect for and remove them. These three acts are more fully discussed below under the heading "Separation acts" (p. 45).

The first regulations prescribing criteria for the classification and valuation of coal lands were approved by Secretary of the Interior Garfield on April 8, 1907. They provided for a maximum workable depth of 1,500 feet and a minimum workable thickness of 2 feet, all lands underlain by coals of less thickness or at greater depth being classified as noncoal land. New regulations were adopted February 19, 1908, and these were in turn superseded by those of April 15, 1908, under which, although the minimum thickness remained unchanged, high-grade coals were classified as workable to a depth of 3,000 feet and certain thicknesses of low-grade bituminous and subbituminous coals to a depth of 2,000 feet. Under all these regulations valuations were based on an estimate in which the number of beds, the thickness of the beds, and the depth of the beds below the surface were taken into account; but the methods of computing prices were such that, for example, a 20-foot bed was valued at no higher price than an 8-foot bed. On April 10, 1909, Secretary Ballinger approved a new set of regulations, drawn on entirely different principles. The minimum thickness was fixed at 14 inches and—a more important change—computations of value were based on the tonnage of coal in the land rather than on the number of beds. The maximum depth was retained at 3,000 feet. These regulations, while far in advance of those preceding, were nevertheless open to criticism because they took little account of certain economic and mining engineering features, such, for example, as the relations between lift and haul, between thickness and mining cost, and between minimum thickness and workable depth. A new set of regulations has just been made effective in which these features have been taken into account and the maximum depth for the highest-grade coals has been increased to 5,000 feet. The prices are based on tonnage, heat value, depth, and thickness. These regulations are given in detail elsewhere in this bulletin (pp. 96–97).

OIL LANDS.

The earliest withdrawals of lands containing oil and gas were made in order to protect oil operators from agricultural entrymen. In 1900 certain lands in Wyoming and California were withdrawn from agricultural entry on representations made by citizens of those States that the lands contained valuable deposits of oil and gas and should be withheld from agricultural entry pending a determination as to their content of oil. These orders and others of similar character were from time to time issued by the General Land Office. The first withdrawal recommended by the Geological Survey was made in 1907. For years the Survey had been doing geologic work in the oil fields of California. Its geologists, studying the conditions of the oil industry as well as the geology and occurrence of oil, early became convinced that unless preventive steps were taken a great amount of fraud would be perpetrated and oil development would be seriously hindered by attempts to obtain oil lands through nonmineral entries. The withdrawal of certain lands was accordingly recommended, and on August 15, 1907, the Acting Secretary of the Interior approved the recommendation and the withdrawal became effective. In 1908 several withdrawals were made in California for the same purpose, and a withdrawal was also made in the Caddo field of Louisiana pending an investigation as to possible means of preventing the enormous waste of natural gas then taking place in that field.

Within a short time it became apparent that the situation was only partly covered by withdrawing oil lands from agricultural entry. The inadequacy of the placer law and its inapplicability to oil lands was clearly recognized. The law was framed to apply to solid minerals; when applied to fluids, such as oil and gas, it at once led to many abuses. Drilling along the boundaries of one claim in order to draw off oil or gas beneath a neighboring claim forced activity in drilling which resulted in production far greater than the demands of the market. The requirement of discovery as a prerequisite to title also forced development and overproduction. It became more and more apparent that oil and gas should be disposed of in terms of barrels or cubic feet rather than in terms of acres. These considerations, together with the advisability of retaining a supply of fuel oil for the use of the Navy, caused the Geological Survey to urge the suspension of all forms of entry on Government oil lands pending the enactment of new legislation by Congress. In consequence Secretary of the Interior Ballinger on September 27, 1909, withdrew from all forms of entry, location, or disposition all public lands believed to contain valuable deposits of oil or gas. As information has since been obtained indicating other public lands to be valuable for these minerals, they also have been withdrawn from all forms of

disposition under the mineral or nonmineral land laws. Field examination has shown that certain lands so withdrawn are not valuable for their oil or gas deposits, and they have been promptly restored to public entry. In one State, Utah, the surface of the lands so withdrawn is open to agricultural entry.

A number of bills providing for the disposal of oil and gas deposits have been introduced in Congress, but none have yet been enacted into law, so that the petroleum withdrawals continue in force and new ones are being made as occasion arises. The need of the Navy for a supply of fuel oil has recently been more strongly recognized, the battleships last authorized being designed to burn oil exclusively. Fully to insure the Nation an adequate supply of fuel oil two naval petroleum reserves aggregating 68,249 acres and estimated to contain at least 250,000,000 barrels of oil have been created in the San Joaquin Valley fields of California, one under date of September 2, 1912, and the second under date of December 18, 1912.

PHOSPHATE LANDS.

Phosphate lands, like oil lands, are withdrawn because of the inadequacy of existing law to dispose of phosphate. Only within comparatively recent years has it been known that important phosphate deposits exist on the public domain, but as soon as such deposits were discovered conflicts arose between entrymen under the placer law and entrymen under the lode law. As a matter of fact neither lode law nor placer law is fitted to phosphate deposits, which occur as sedimentary beds interstratified with barren rocks in a manner identical with that in which coal occurs. The placer law provides for the disposition of all forms of deposit except rock in place. The western phosphate deposits are clearly rock in place. Moreover, some of them lie at great depth and are as difficult to mine as coal or any other solid mineral. It is clear that the placer law is not logically applicable to these deposits. Under the lode law a vein which outcrops within the limits of a claim may be followed to indefinite depths and distances so long as the end lines of the claim are not crossed. A phosphate deposit is essentially an interstratified bed, some deposits extending for many miles and being involved in great folds and undulations. The application of the apex law to such deposits would assuredly result in great confusion. For instance, if two sets or series of lode claims are located along the outcrop of a bed of phosphate that occupies a geologic basin and outcrops around its margin, one set of claimants on one side, the other on the opposite side, each set of claimants might be entitled to the bed throughout its extent from outcrop to outcrop. Thus the same property might be disposed of to two separate claimants, each of whom would have a good title. It is obvious that the lode law, under

which such a condition is possible, is not suited to the disposition of phosphate deposits.

Still another consideration led to the withdrawal of phosphate lands. Agriculture in the United States is comparatively young, so that the exhaustion of lands from long-continued use has not yet begun to be generally felt. In a large part of Europe, however, phosphate fertilization has become an economic necessity, and as a result the greater part of the phosphate mined in this country is being exported. It has seemed to many students of the situation that the United States should not part with a deposit so vital to its agricultural future. Pending consideration of this question by Congress, as well as the enactment of laws more applicable than the lode and placer laws, the first phosphate withdrawal was made by the Department of the Interior on December 9, 1908. Other withdrawals have been made from time to time as additional valuable deposits of phosphate have been discovered. Since the first withdrawal the known area of phosphate lands has been greatly increased by the explorations of the Geological Survey, and the reserves now include lands in Wyoming, Idaho, Utah, Montana, and Florida.

POTASH LANDS.

The agricultural industry of the United States has begun to feel the need for the rejuvenation of lands by the application of potash. All of this mineral heretofore used, in manufacturing as well as in agriculture, has been imported from Germany. A threatened termination of the supply from that source by the German Government lent acute interest to the question whether or not potash deposits are to be found in the United States, and on March 4, 1911, Congress appropriated $20,000 for research and exploration for potash deposits by the Geological Survey. This appropriation was renewed the following year. Promising indications have been discovered, exploration work is being actively continued, and three areas have been found where the existence of potash salts warrants withdrawal of the lands. The first potash withdrawal covered one of these areas and was made on January 16, 1913. It is the present intention to recommend the withdrawal of all valuable deposits found and all lands in which there is a reasonable probability of the occurrence of valuable potash, these withdrawals to remain in force until Congress has provided more appropriate legislation than the existing placer law.

METALLIFEROUS MINERAL LANDS.

An unusual type of withdrawal, designated "Mineral-land withdrawal No. 1," was made in Arizona by the President on September 23, 1912. It covers an area in which investigations made by the Geological Survey show geologic conditions favorable to the occurrence of deep-seated deposits of copper. The deposits in this district are of such nature that no surface discovery, such as is required by the lode law, can be made. As a result valid locations can not be made upon the lands until valuable minerals have been discovered therein, either by deep drilling or deep shafting. There was danger that before either of these types of prospecting could be completed attempts would be made to obtain title to the lands by means of State selections or other nonmineral entries. Accordingly the President directed that the area be included in a withdrawal. By the terms of the withdrawal act the withdrawn lands are open to exploration and purchase under the mining laws, so far as they apply to metalliferous minerals. Thus the lands are reserved for exploration as to their metalliferous value but are not open to other forms of entry.

WATER-POWER SITES.

In messages to Congress during 1908 and 1909 President Roosevelt called attention to the danger of an uncontrolled monopoly of water-power development and to the desirability of preventing power sites on the public domain from falling into the hands of speculators and monopolists. As early as February 26, 1908, in a message transmitting a report of the Inland Waterways Commission, he advocated legislation providing for the leasing of such sites rather than their alienation. The report of the Inland Waterways Commission contains the following statement:

> Wherever water is now or will hereafter become the chief source of power, the monopolization of electricity from running streams involves monopoly of power for the transportation of freight and passengers, for manufacturing, and for supplying light, heat, and other domestic, agricultural, and municipal necessities to such an extent that unless regulated it will entail monopolistic control of the daily life of our people in an unprecedented degree.

Since that time President Taft, Senator Burton, Secretaries Garfield, Fisher, and Stimson, and many others have advocated a revision of the laws pertaining to lands valuable for water powers and have especially urged the retention of their control by the United States.

In the winter of 1908 and 1909, under the direction of President Roosevelt and Secretary Garfield, a number of withdrawals were made covering streams in the Rocky Mountain and Pacific coast States on recommendation of the Reclamation Service. These orders of withdrawal covered wide areas, and as the best agricultural lands in the West are in the vicinity of streams, a great deal of popular discontent and criticism followed. Secretary Ballinger, soon after his appointment, ordered the restoration of all the withdrawn lands, and many such restorations were made, mainly in the latter part of

March and the early part of April, 1909. On April 28, 1909, Secretary Ballinger directed the Geological Survey to make an investigation of water-power sites on the public domain and to recommend as early as possible any withdrawals necessary to protect them pending the enactment of legislation to be recommended by the President. The first withdrawal under this order was recommended by the Survey on May 3, 1909, and approved by Secretary Ballinger on the following day. Since then many such power-site withdrawals have been made, so that at the present time it is believed that the greater number of the valuable power sites on the public domain are withdrawn from entry pending legislation by Congress for their appropriate disposal. The available information does not indicate that there is now in existence any all-inclusive, nation-wide water-power trust such as has been feared by students of the situation. Certain powerful and far-sighted interests have, however, made very determined attempts to acquire control of valuable sites in advance of the possibility of developing a market for the power that might be produced. The passing of these strategic points from public ownership would seriously impair the control by public authority of water-power operations, which are inherently monopolistic. As soon as the Survey obtains knowledge of such sites their withdrawal is recommended. Field examinations have shown that certain areas withdrawn were not so valuable as had at first been supposed and these have been promptly restored.

RESERVOIR SITES.

Reference has already been made to the act of 1888 (25 Stat., 527) and to the fact that certain tracts specially valuable for the construction of reservoirs were segregated under that act and still remain withdrawn pending their restoration by Congress. In its study of the water resources of the public domain the Survey found that attempts were being made to obtain possession of advantageous reservoir sites, not for the purpose of development but for some inferior use or for speculation. Pending legislation by Congress which would make such acquisition impossible a number of reservoir-site withdrawals have been made, the first one having been recommended by the Survey on January 13, 1911, and approved by President Taft on January 17, 1911.

PUBLIC WATER RESERVES.

In the great semiarid grazing areas of the West watering places are few and the range is, in places, monopolized by control of the water holes. It has been common practice for a stock owner to file some form of land scrip or State selection upon all the springs in a district and thereby to exclude all other stock owners from the district as effectually as if he owned every acre of it. In most places the public range of the West is greatly overcrowded and the competition for possession of the water holes has been exceedingly bitter, with the advantage in favor of the large owner, on account of his greater ability to purchase land scrip. Exclusion from the watering places has ruined more than one stock grower and violence has not infrequently accompanied the struggle for their possession. This condition of affairs led members of the Land Office and of the Survey to urge that the watering places on the public range be retained in Government ownership and thrown open to the use of all comers. The possibility of the passage by Congress of a grazing law added to the advisability of such withdrawals. The present conditions on the public range are by no means satisfactory. They give undue advantage to the large stock raiser and are resulting in the deterioration and in many areas the ruin of the range. Several bills have been introduced in Congress providing for Government supervision of grazing under a leasing system. If such a law is passed it is highly important that a sufficient number of watering places to permit the administration of leases should remain in Government ownership. On March 20, 1912, public water reserve No. 1 was recommended by the Survey and approved by the President. Other public water reserves are being created as rapidly as field data can be considered.

WITHDRAWAL ACTS.

The early coal, oil, phosphate, and power-site withdrawals were made by the Secretary of the Interior in the exercise of his executive discretion and without specific authority granted by Congress. The right of the Executive Department to make land withdrawals has been established by numerous court decisions relating to withdrawals covering small areas, but as soon as general withdrawals of large areas were made interested parties began to question their validity. Many claimants asserted their belief in the department's lack of authority by proceeding in disregard and contravention of the withdrawals. This type of action was especially frequent in the oil fields of California and it early became apparent that, unless the validity of the withdrawals was clearly established, millions of barrels of oil would be taken from withdrawn lands while a decision was being obtained from the courts. Accordingly, Congress was urged to pass an act confirming the power of the Executive to withdraw public lands, and on June 25, 1910, a law was approved entitled "An act to authorize the President of the United States to make withdrawals of public lands in certain cases" (36 Stat., 847). That this act was merely confirmatory of powers already reposing in

the President and his cabinet is shown by the report of the Senate Committee on Public Lands, from which the following is quoted:

> The power conferred upon the President by the proposed substitute is a power that he has possessed and exercised almost from the inception of our public-land system and is a power that he still possesses and exercises.
>
> The power of the President to reserve public lands from sale and entry rests upon various statutes, upon numerous decisions of the courts, and upon long-established and long-recognized usage.
>
> * * * * * * *
>
> It is only lately that this power has been doubted and questioned, and the object of the proposed substitute is to make it definite and clear beyond all dispute that the President possesses this power of withdrawal.

Immediately after the passage of the act of June 25, 1910, Executive orders were issued by the President ratifying, confirming, and continuing in full force and effect all outstanding orders of withdrawal. Since that date all new withdrawals have been made in accordance with the provisions of this act and have been approved by the President.

The act of June 25, 1910, contains several provisions modifying preexisting practice. In the first place, it provides that lands which are embraced in lawful homestead or desert-land entries made prior to the date of withdrawal or on which valid settlement has been made and maintained shall be excepted from the force and effect of the withdrawal order so long as the entryman or settler continues to comply with the law. Thus the effect of an order of withdrawal on a preexisting homestead or desert-land entry depends on the initial and continued good faith of the entryman, rather than on the value of his land for purposes other than that under which his entry was made. The second important provision is that the rights of any person who at the date of a withdrawal order is a bona fide occupant or claimant of oil or gas bearing lands and who at that date is in diligent prosecution of work leading to the discovery of oil or gas shall not be affected or impaired by the order so long as diligent prosecution of the work is continued. It is to be noted that this provision makes the critical date that of the withdrawal order, even though that order was made before the passage of the withdrawal act. The department has held that what constitutes diligent prosecution of work leading to the discovery of oil or gas must be decided upon the facts in each case. It is safe to assume, however, that many of the subterfuges that have been commonly practiced for the purpose of holding claims will not be considered effective against the withdrawal orders.

Section 2 of the act provided that withdrawn lands should "be open to exploration, discovery, occupation, and purchase under the mining laws of the United States so far as the same apply to minerals other

than coal, oil, gas, and phosphates." There were two serious faults in this provision. For one thing, it did not permit the withdrawal of lands valuable for other minerals than the four enumerated. Thus, when interest in the potash situation became general and the desirability of reserving potash lands from entry was perceived it was not possible to make the desired withdrawals because of this provision in the withdrawal act. Furthermore, advantage was taken of this clause to locate valuable power sites as building-stone placers and to include oil lands of great value in placer claims located on comparatively worthless deposits of gypsum. These conditions led the President to urge upon Congress the amendment of the section by providing that withdrawn lands should be open to exploration and purchase under the mining laws for metalliferous minerals only, and on August 24, 1912, Congress so amended the original withdrawal act (37 Stat., 497). Public-land withdrawals now segregate lands from all forms of entry, location, or disposition except metalliferous mineral claims, preexisting homestead and desert-land entries and valid settlements, and oil placers on which work is being diligently prosecuted at the date of withdrawal.

SEPARATION ACTS.

The carrying out of the withdrawal policy for protecting the mineral and water resources of the public domain is in many cases rendered difficult and embarrassing by the agricultural value of the land withdrawn. If valuable water-power or reservoir sites were invariably valueless for farming, or if mineral and agricultural values could not coexist, no hardship would be imposed by and no retardation of development would result from the making of withdrawals. But some of the best farming lands in the West are underlain by coal or phosphate, and some are so situated as to be of strategic importance in power development. Any hindrance to bona fide home building or other agricultural development of the public domain is indeed unfortunate, but in order to protect the public's natural resources withdrawals resulting in such hindrance have been necessary. For certain lands the situation has been relieved by the passage of acts separating the surface right from the right to the underlying minerals. The first of these acts was that of March 3, 1909 (35 Stat., 844), which provides that persons who have entered or selected under the nonmineral laws lands subsequently classified, claimed, or reported as being valuable for coal may elect to receive patent to their lands by reserving to the United States the coal deposits and the right to prospect for and mine them. The act contains a provision for the indemnification of the surface owner for damages to his estate by prospecting or mining and a further provision that the owner of the

surface patent shall have the right to mine coal for his own use prior to the disposal of the coal deposits by the United States. This act granted relief only for entries or selections antedating withdrawal. The act of June 22, 1910 (36 Stat., 583), goes a step further with regard to coal lands and provides that homestead entries, desert-land entries, and Carey Act selections may be made on lands withdrawn or classified as coal whenever it is stated in the application that the entry is made to obtain title containing a reservation of the coal to the United States. In this, as in the previous act, provision is made for damages to the surface estate by prospecting or mining. The act of April 30, 1912 (37 Stat., 105), extends the act of June 22, 1910, to include State selections and isolated tracts.

An act approved August 24, 1912 (37 Stat., 496), provides for the entry or selection of withdrawn or classified oil and gas lands in the State of Utah, with a reservation to the United States of the oil or gas. The provisions of the act are similar to those of the coal act of June 22, 1910, and the classes of entries and selections permitted are the same as those in that act as amended by the act of April 30, 1912.

DESIRABLE NEW LEGISLATION.

In carrying out its function of classifying the public lands and in making its fund of information available in the administration of the existing land laws the Geological Survey has become acutely cognizant of the need for certain new legislation. The laws desired are primarily of two types and embody two fundamental necessities—first, the extension of the principle of the separation of estates, and second, the application of the leasing principle to the disposition of natural resources.

As has already been pointed out, the public lands can not be divided into classes each of which is valuable for one purpose only. Instead, the same tract of land may be valuable for two or more resources. In one tract—for example, agricultural land that is underlain by coal—both resources may be utilized at the same time without interfering with each other. In another tract—for example, agricultural land within a reservoir site—the land may be valuable for one resource only until it is utilized for another. In the first case the problem is so to frame the laws that no resource will be forced to await the development of the other. In the second case the problem is to permit the use of the land for one purpose pending its use for another without losing public control of the development of the second. In both cases the answer is found in a separation of estates. The extension of this principle, now applied to coal, to withdrawn and classified minerals and to the uses of water resources would permit the retention of the mineral deposits and power and

reservoir sites in public ownership pending appropriate legislation by Congress without in any way retarding agricultural development. Bills have already been introduced applying this principle to oil in other States than Utah and to phosphate in the State of Idaho. It is to be hoped that such bills will be passed and approved, or, better still, that a comprehensive act providing for the separation of the various estates will be introduced and enacted.

Nearly every student of the situation is agreed that the leasing system is far better than any other for disposing of natural resources. This conclusion is based partly on the logic of theoretical considerations, partly on the experience of other countries, such as the Australasian States, and partly on the fact that the leasing system is rapidly replacing all others in commercial practice in the United States. A single instance may be cited: Over 90 per cent of the oil production of the United States in 1911 came from leased lands. In the public interest leasing is to be preferred to sale for several reasons. In the first place, the sale of mineral lands at appraised values per acre presents problems of great difficulty and of uncertain solution, because of the number of factors involved. For example, in valuing coal lands under the present coal-land law or in valuing phosphate lands, should a similar law be enacted for that mineral, the items bearing on the value which should be fixed are so numerous, so difficult to estimate, and so variable that it is well-nigh impossible to arrive at conclusions which give the proper weight to all the factors involved. In valuing coal lands the end striven for has been to fix prices which shall be low enough to permit purchases for immediate development but which shall be high enough to prohibit speculative purchases or long-term investments. However, the proper consideration of transportation charges, market conditions, competing supply, and cost of labor is affected by so much uncertainty that it is difficult to fix a thoroughly satisfactory price for which lands should now be sold. When it is considered that the lands are to be sold in the indefinite future at the prices fixed now, the difficulties of the task become apparent. None of these difficulties would attend in the same degree the administration of a lease law under which the coal or phosphate would be paid for at a royalty per ton as mined. The fixing of the royalty would be very much simpler than the present task.

Attention has already been called to the inappropriateness of selling oil and gas by the acre. The distance within which oil and gas may be drawn off by a single well is not definitely known and is, of course, variable, but it is at least certain that a well drilled close to a property line will draw these minerals from immediately adjoining portions of neighboring tracts. Under a leasing law the person required to pay for deposits of these minerals would not be the person

under whose land they originally occurred but the person from whose land they were produced, and the price would be fixed by unit of quantity. The fairness of this plan is obvious.

The uncertainties as to market value of potash and other nonmetals except coal, oil, gas, and phosphate make the payment of a sale price undesirable and the payment for the minerals as mined much more advantageous to the producer. In fact, one of the main arguments for the leasing as opposed to the sale system, not only for potash but for coal, oil, gas, and phosphate as well, is that instead of being required to advance the entire price of the land at the outset, the payments are made only as the mineral is produced, thus enabling the operator to begin operations with a much smaller initial investment. This is certainly advantageous to the small operator. Moreover, under a lease law the many uncertainties which enter into the fixing of sale prices would be eliminated, since only the quantity produced would be paid for.

Probably the present mineral laws are more satisfactory when applied to the metals than to the other minerals. Without doubt even here a lease law would effect a marked improvement on present practice, but if they were modified in three features the laws applicable to metalliferous lands would be reasonably satisfactory to the miner and to the public at large. In any event, the law of the apex should be abolished, the provisions regarding discovery should be modified, and the period for which a claim may be held without patenting should be limited. Regarding the first of these points there is little need for argument. Mining congresses and bar associations have alike recommended the repeal of the apex provision and shown conclusively the detriment which it is and has been to the mining industry. That it is possible to do away with it without resultant confusion is shown by the experience of British Columbia. One point, however, should not be overlooked—if the law of the apex is abolished the width of the claim should be increased in order to assure sufficient values to warrant the opening of a mine.

The requirement that mineral shall be discovered as a prerequisite to location is one that works undue hardship to those exploiting deep-seated deposits that do not crop out at the surface, such as those included in the mineral-land withdrawal in Arizona. Such deposits are by no means rare in certain mining districts of the West, and the law should be so modified as to provide either for some adequately safeguarded substitute for discovery or for the protection of the miner during the long and expensive prospecting which he must carry on before minerals can be discovered. Such protection would be best afforded by a provision for a prospecting permit of limited duration, to be granted only if the geologic conditions are at least moderately favorable for the occurrence of the mineral sought.

Under the law as it now stands a claim may be held indefinitely without an attempt to obtain patent, and so long as the annual assessment work is performed the claim is secure against adverse claimants. Until patent is issued no taxes are assessable by the State, and many producing mines refrain from patenting in order to avoid taxation. A limit to the number of years that a claim may be held pending the institution of patent proceedings would correct this abuse.

It is not only with relation to mineral deposits nor by comparison with a sale system that a leasing system is advocated. Leasing should replace the present permit system, under which rights of way across the public domain are granted for reservoir sites, power development and transmission, and irrigation works. Under the existing laws the right of way granted is either in perpetuity or is revocable in the discretion of the Secretary of the Interior. Both of these conditions are undesirable—the first because the resource passes forever beyond the direct control of the public, which thus becomes powerless to guard against misuse, disuse, or monopoly; the second because the capital which is required in the construction of such enterprises is not sufficiently protected. Between the grant in perpetuity, which inadequately protects the public, and the revocable permit, which inadequately protects the capital invested, lies the lease, which adequately protects both. By leasing rights of way for a fixed period of years absolute control would periodically return to the public, while the investor would be secure for a period long enough for his investment to return a profit.

If a lease law is to be adopted certain provisions should be incorporated in it, whether it is for a single resource or for all. In the first place the end to be attained is not revenue for the Government but is rather the retention of control in the public. It would be a long step backward to return to the early policy of using the public lands as a means of Federal revenue, and any lease law enacted should be so framed as to encourage development, prohibit speculation, and add nothing to the cost of the resource to the consumer. The States in which the lands are situated should be compensated for the loss of taxes which they would suffer from the permanent retention of the fee to natural resources in the National Government. Doubtless the simplest way to accomplish this is to provide that a certain percentage of net receipts from leasing shall go to the State in which the lands are situated. The term of a lease should be long enough to permit profitable investment and development. It should not be longer than is necessary to furnish an adequate return on the amount invested.

Whatever action Congress may decide to take regarding the natural resources now in public ownership should not be much longer de-

layed. The present withdrawals are a temporary expedient whose employment should be rendered unnecessary as soon as possible. It can not be economically advantageous to the country to have millions of acres of lands, valuable for petroleum, phosphate, or potash or for power or reservoir sites, absolutely segregated from all forms of disposal for an indefinite period. Some of the lands have already been so withdrawn for nearly four years. Congress should be fully informed concerning all the factors to be considered, but it should also act promptly.

CLASSIFICATION OF MINERAL LANDS.

FIELD METHODS.

DEVELOPMENT.

Since the United States Geological Survey was organized the methods it employs in its diverse field investigations have gradually become more refined and more precise. If a topographic map made by the Survey 20 years ago is compared with one of its recent maps the difference will be patent even to the untechnical critic, yet many of the important improvements adopted during that period do not appear on the map. The closer and more accurate triangulation net, the great increase in the numbers of intersected points and of level lines, and the general completeness of both vertical and horizontal control are not directly reproduced on the completed sheet, but they have been used in its preparation and give it far greater accuracy and expressiveness than the earlier maps. The methods employed by the engineers of the water-resources branch and by the geologists of the geologic branch have likewise undergone steady and consistent development.

Perhaps nothing in recent years has so directly stimulated the employment of more precise methods in field work than the requirements of land classification, and the development here is well exemplified in the work done by the coal geologists. The law under which coal land is classified, unlike the laws controlling the classification of lands containing other mineral resources, requires a valuation of the land. It is therefore especially necessary to trace the outcrops of coal beds with exactness and to fix their relations to the units of the public-land surveys by precise methods. This has led to the introduction of refinements that are not generally considered necessary in preparing a geologic folio or in determining the general relations of the formations in any region. It is perhaps worth while to trace a part of this development of the field methods employed in the classification of coal lands, as an example of a general improvement and as an introduction to a discussion of the methods now

generally used by the geologist in the solution of problems of classification.

The acts separating the mineral and agricultural estates of coal lands were not passed until 1909 and 1910, so that the withdrawals of coal land promulgated prior to that time prevented the initiation of both homestead rights and coal entry on the same tract. In order that this interference with agricultural development might be reduced to a minimum, the first examinations were directed toward the correction of the withdrawals by the prompt elimination from them of the noncoal land. The methods first used, therefore, were planned with the idea of covering large areas quickly and did not involve a marked departure from reconnaissance methods already in vogue, except that it became necessary to tie the investigations as closely as possible to such cadastral surveys as existed. One of the first methods employed at the beginning of the work of coal-land classification in 1906 and 1907 was that of retracing land lines. In doing this work the field men rode along the section lines established by the General Land Office, using the pocket compass to determine direction and horse pacing to measure distance. Coal outcrops along the section lines were mapped, the geology was studied in a general way, and a sketch of the topography was made.

In areas in which the absence of satisfactory land corners made it necessary to construct a map independently of the Land Office surveys a different method was adopted. By the use of a 15-inch plane table and an open-sight alidade a main or control traverse was run, completing a circuit of the field, distances being measured by intersections from points previously located and altitudes determined with an aneroid barometer. The topography and geology were mapped by means of a network of secondary traverse lines tied to the primary traverse. As the work progressed a more or less complete system of triangulation was established which could be used in adjusting the main plane-table traverse, and in turn the plane-table traverse served to check meander traverse. In running these meander traverses a pocket compass was used for obtaining directions, distances were measured by pacing, and elevations were determined by aneroid. The meander-traverse lines were plotted in the field as the work advanced, a small celluloid protractor being used for laying off angles and a scale graduated to correspond to the scale of the township plats being used for measuring horizontal distances. During the field work especial care was taken to locate whatever land corners existed, in the hope that these corners would serve as a basis for later adjustment of the township and section lines on the map.

These two methods probably represent fairly the general field methods in use during 1906 and 1907, in connection with classification of coal land. Some idea as to the speed attained in this work

may be formed from the statement that on an average a township (36 square miles) was completed by one man in four days. The following figures will also give some idea of the effectiveness of these methods for the purpose which they were designed to accomplish.

During the last six months of 1906 the total area withdrawn for examination was approximately 66,000,000 acres, and by the close of that year, as a result of the field examinations, approximately 2,000,000 acres had been restored to public entry. During 1907 there was an additional preliminary withdrawal of approximately 2,000,000 acres and by the end of the same year about 34,000,000 acres had been added to the restorations. Thus, of the 68,000,000 acres withdrawn during the first two years about 36,000,000 acres were restored as noncoal land as a result of the rapid methods then used. Had the Survey attempted a detailed study of these lands from the beginning, there would have been much undesirable delay in the restoration of large bodies of noncoal lands to entry. These early relatively inexact methods were therefore well adapted to the ends they were designed to accomplish.

The principal areas of coal land having been outlined by reconnaissance surveys, attention was next turned to more improved methods of field work to meet the constantly growing need for better and more detailed classification. The reconnaissance method was then replaced by that in which plane table and telescopic alidade are employed. The most satisfactory alidade, which was designed by one of the geologists engaged in the classification work, is a small instrument carrying a telescope fitted with cross wires for stadia work and a vertical arc for determining differences of altitude.

The details of method used in plane-table mapping are varied according to the topography and the forest conditions of the area mapped, as well as according to the condition of the land survey. In an area where there have been no land surveys or where those that have been made are very poor, the triangulation or station method is preferred, but stadia work only is practicable in certain areas—for example, heavily wooded districts or regions cut by deep, narrow canyons. Either method, however, gives excellent results, for by either the coal outcrop is actually traced in the field and the exact horizontal and vertical positions are determined for every observation. In connection with these precise locations full data are procured on the character of the coal. If the region is undeveloped and no coal mines or prospect pits are available for examination, openings are made and sections are measured wherever such work is necessary to give adequate data for classification.

Perhaps the most detailed work that is now being done in the coal areas is that carried on in those districts where the geologist works in conjunction with the topographer. This method results in a reduced cost of the work and a great degree of accuracy in location. In work of this kind the geologist usually examines the territory in advance of the topographer, prospecting the coal bed and carefully marking by means of flags all prospects and coal outcrops which he desires the topographer to locate. The topographer, in the course of his mapping, determines both the horizontal and the vertical positions of all points flagged by the geologist. This work is done instrumentally and with great accuracy, the probable limit of error in the horizontal location of any point being less than 20 feet and in the vertical location less than 5 feet. With many points on the outcrop thus accurately located, underground structure can be determined with a degree of accuracy that has seldom been attained in geologic work.

With this preliminary statement, it is proposed to set forth briefly some of the methods now in use under the various conditions that confront the geologist who is assigned to the task of making a mineral classification of a specific area.

A. If he is required to make a detailed survey, he will find one of the following conditions existing:

(*a*) A topographic base is available.

(*b*) A base map is not available but must be made.

(*c*) A topographic base is not available and is not essential, the land survey sufficing as a base map.

B. If he is making a preliminary survey only he will use reconnaissance methods.

DETAILED SURVEY.

METHODS USED WHEN A TOPOGRAPHIC BASE IS AVAILABLE.

It is desirable that the examination of the mineral deposits in regions of especial economic importance be based on an accurate topographic map prepared in advance of the geologic examination. Such a map, on which are shown the relief by contours of appropriate intervals, the position and character of the drainageways, and the location of land corners, roads, houses, and the bench marks and triangulation stations established by the topographers, enables the geologist to determine by surveyor's methods the location of the numerous points at which he makes observations, with a minimum expenditure of time and with a degree of precision adequate to the scale of the map and the work in hand. The scales which are generally used by the Geological Survey in work of this character are about 1½ or 2 inches to the mile, with contour intervals of 10, 20, or 50 feet. The degree of accuracy attained in work on such maps is represented by the width of a carefully drawn pencil line, or less than 20 feet for locations where refined plane-table methods are employed—for example, along the outcrop of the coal, oil sand, or phosphate bed—and by a

somewhat variable larger figure for locations requiring a less degree of accuracy and made with less precise instruments. The actual elevation of observations along the outcrop of the valuable bed is determined with surveying instruments, so that the error is rarely in excess of 5 feet, an amount which is practically negligible in mountainous regions. In special cases, however, a higher degree of precision is attained.

The information collected by the geologist in the field relates to the quality and thickness of the economic deposit, the position of its outcrop relative to legal subdivisions, and its depth and accessibility where covered. He maps the actual position of the outcrop of the coal bed, oil sand, or phosphate bed by making careful locations at many points, as described above, and where possible determines the attitude of the bed by many careful dip readings with a clinometer or by computation from its elevation at several points. He also maps the position of the top and bottom of the overlying and underlying beds, so that the completed map shows the actual area covered by the outcrop of beds of sandstone, limestone, conglomerate, shale, or such other rocks as may be present in the region. He further determines the attitude of these rocks and collects typical samples and fossils which serve to determine their relative age. Part of this information is represented on the map by symbols whose significance is expressed in the accompanying legend, and part is recorded in suitable notebooks for use in the preparation of reports. This information is put together in a tabular form showing the normal arrangement of the beds, which is technically spoken of as a columnar section. Such a section shows the normal distance through the strata from the economic bed to the top or bottom of any one of the constantly related overlying or underlying beds, and it is used in combination with the data on the outcrop of the overlying rocks in working out the theoretical underground position of the bed. The methods of making the computation are explained in detail in the following discussion of the examination of areas for which a topographic base is not available.

The deposits of present economic importance or of promise for the future are sampled at many points where the natural exposures are favorable and in other places by means of pits, trenches, or drill holes. All the samples from any one deposit are taken by a uniform method designed for that kind of material.

METHODS USED WHEN A BASE MAP MUST BE PREPARED.

In the detailed geologic study of an area it is usually necessary to construct a map which shall place before the eye of the geologist all the available information concerning the area in such space that it can be viewed as a whole and the correct relations of details comprehended as they could not be on the ground. Such a map to be of

the greatest value should show not only geology but surface relief and the positions of streams, roads, and houses, with the legal subdivisions of the public-land surveys, in order that the geology may appear in its true relation to surface features. The construction of a map giving such details is, strictly speaking, the work of the topographer rather than of the geologist, but the latter may be called upon to examine an area for which no adequate base map has been prepared and he is therefore obliged to construct a map, either contoured or plain, on which to record the geology. Such a map may be made by the use of various instruments, perhaps the most satisfactory in both accuracy and speed being the plane table and the telescopic alidade. These instruments used with a system of triangulation are particularly adapted to open country in which signals can be seen for considerable distances. In areas where, for various reasons, it is impossible to sight distant signals the method of stadia traverse is employed, the same instruments being used in conjunction with the stadia rod.

In constructing a map by a system of triangulation, the procedure is briefly as follows:

A base line is measured and the plane table is set up at one end of it and properly adjusted so that one edge of the table lies in a north-south line. The base line is then plotted on a selected scale, usually from 1 to 4 inches to the mile, and sights are taken and lines drawn in the direction of monuments on prominent hilltops. The plane table is then transferred to the other end of the base line and correctly oriented by back sight. Sights are then taken and lines drawn in the direction of the monuments sighted from the first station. The intersection of the two lines drawn in the direction of each monument establishes its location in relation to the base line as indicated on the map. After the various signals are located in a certain area the plane table may be set up at any point whose location is not known, and after it is approximately oriented by compass sights may be taken to the points already located and the position of the instrument determined by lines drawn from the locations of these signals on the map. These lines should exactly meet at a point. If they do not so meet there is some inaccuracy either in the previous work or in the orientation of the plane table. It is thus possible to keep a close check on the work and points may be located as accurately as the scale of the map allows.

On a scale of 2 inches to the mile a distance of 10 feet would be represented by the width of a fine pencil line, and it is not possible to plot a distance of, say, 5 feet. A distance of 10 or 15 feet, however, is perceptible, and locations may be accurately made within such distances. If the scale is increased to 4 inches to the mile the error in the location of a point should not exceed 10 feet. After the primary signals are established over the township the base map

and the geologic map may be constructed simultaneously—that is, in tracing the exposures of some particular bed, such as a coal or phosphate bed or an oil sand, the geologist may sketch in the roads or streams or topographic features near which his instrument happens to be set.

In mapping a particular area geologically as many points are located as are necessary for the degree of accuracy desired on the map. In critical parts of an oil field, where all dip readings are located by the plane table, observations may be taken every 400 or 500 feet, but in parts of the area outside of the probable extent of the oil pool dip readings taken every mile may be amply sufficient if the dip is regular. Places at which fossils are collected are marked on the map and also places at which rock specimens and coal, phosphate, or oil samples are taken, as well as localities where sections of the beds or other geologic observations are made. In the construction of such a map any land corners that may be found are located from the signals previously established, just as rock outcrops and other features of interest are located. The land net is afterward drawn in from the corners which have been found, and any inaccuracies and irregularities in the old surveys will thus be detected. In land classification the tracts are always described with reference to these surveys, so it is very essential to locate as many of the corners as possible in order that the position of the land lines may be accurately known. The time required to construct a map of this kind varies greatly with the nature of the country and the character of the geology. One man can, as a rule, establish primary control over a township in one to three days, the time required being dependent entirely on the number of locations made and the nature of the country traversed.

The method of locating important rock outcrops by stadia traverse may be successfully employed in conjunction with location by triangulation, or it may be used alone without triangulation. In running a traverse with stadia the instrument man can not work alone but must employ the services of a rodman. The plane table is set at some known point, the stadia rod is held on the point whose location is desired, and the direction from the point occupied to the other point is drawn on the map by means of the alidade. The distance is read by means of the stadia and platted on the map by the use of a scale, in the direction already recorded; this locates the second point. The instrument is then transferred to a third point, the location of which is determined by a reversal of the method used in locating the second. The rod is then moved ahead and the process is repeated. Such a method is most useful when a coal or phosphate bed or an oil sand is to be outlined in great detail or when the work is done in deep

valleys or canyons from which it is difficult to sight triangulation signals.

In the above description no mention has been made of the method of determining elevations, which in much of the work are of great importance. With a telescopic alidade the angle of elevation or depression from one point to another can be accurately determined. This angle being known and the distance between the two points being measured with a scale from the locations of the points on the map or by reading a stadia rod, the problem resolves itself into the solution of a right-angle triangle in which one side and one of the acute angles are known, the side to be determined representing the vertical distance between the two points, or, in other words, the difference of elevation between them. The altitude of a starting point being known or assumed, it is possible to calculate the altitude of any number of points in any direction from it. Elevations determined by this method are not absolutely exact but are of sufficient accuracy for most purposes of geologic mapping. In ordinary practice they are correct within 5 or 6 feet, but with certain refinements of work the error can be reduced to 1 foot or even less.

It is advantageous to represent on a map in some manner the form of the rock folds, which may or may not correspond to the surface relief. Ordinarily surface relief is represented on a contour map by lines drawn to indicate definite elevations above sea level, one line, for example, at 4,000 feet, the next at 4,100 feet, the next at 4,200 feet, and so on. These lines not only show the configuration of the surface but also give approximately the elevation of any point within the area thus mapped. It is possible to contour in the same way the surface of an oil-bearing sandstone or a coal or phosphate bed which has been bent into a fold. Such contours are known as structure contours. They bear no necessary relation to surface relief. In fact, a valley may occupy the axis of an anticline or a ridge the axis of a syncline.

Sedimentary beds deposited one above another during a period in which there has been no earth movement are parallel—that is, if one sandstone so deposited is 2,000 feet above another at one place it is probably 2,000 feet above the other 1 mile or 5 miles away. If since their deposition the beds have been tilted from the horizontal, the dip of a bed at the surface in general represents the dip of the beds below it. If a certain oil-bearing sandstone dips 5° E. where it appears at the surface and overlying beds of the same formation outcropping east of the exposure of the first bed also dip 5° in the same direction, it is probable that the first bed and all intermediate beds have the same dip in this area also. A dip of 1° is equivalent to about 92 feet in a mile, and a dip of 5° to about 460 feet in a mile.

Therefore a bed that dips 5° E. under a horizontal plain is 460 feet beneath the surface at a point 1 mile east of the outcrop.

If it appears from surface exposures of the overlying rocks that the dip is not constant, allowance must be made for the variations in the calculation. In areas in which drilling has been carried on the records of the wells are invaluable as giving accurately the depths of beds beneath the surface, thus checking the deductions from surface evidence.

The locations of structure contours are based on a variety of data. If a well whose altitude at the surface is 4,000 feet strikes an oil sand, for example, at a depth of 1,000 feet, it is evident that the 3,000-foot contour on the oil sand passes through the location of this well on the map. If the rocks dip toward the east and a sandstone known to be 2,000 feet above the oil sand outcrops half a mile east of the well at an altitude of 4,500 feet, the oil sand should be at this point 2,500 feet above the sea, or, in other words, the 2,500-foot contour should pass through the location of this sandstone outcrop on the map. If the dip of the rocks exposed at the surface is constant between the mouth of the well and the outcrop of the sandstone it indicates that probably the oil sand dips regularly to the east between these points, and the contours of 2,600, 2,700, 2,800, and 2,900 feet may be spaced evenly between the 2,500-foot contour at the sandstone outcrop and the 3,000-foot contour at the well. Should the dip, as indicated by the surface exposures, be irregular between the two points, the contours are spaced accordingly, being placed nearest together where the dip is greatest and farthest apart where the dip is least.

After a structure-contour map is completed it is possible to estimate from it the depth of a bed of economic importance at any required point, if the surface altitude of the point is known.

METHODS FOLLOWED WHEN THE LAND OFFICE SURVEY AFFORDS A BASE MAP.

More than half of the coal land still owned by the Government lies in the rather sparsely settled plains region which has not been mapped topographically but has been covered by the cadastral surveys of the General Land Office. For such land, a topographic map not being essential, a method of survey different in some ways from those described above has been adopted. Plane table, telescopic alidade, and stadia rod are used as in the other work, but the results of the surveys made by the General Land Office are used as a base for the work, and the township forms a unit, the results being sufficiently detailed and accurate to permit classification by legal subdivisions. As previously stated, some of these surveys are not accurate, but they are official and in general they provide a suitable base for the survey. Locations and measurements are therefore accepted as recorded on the Land Office plats unless the field work proves them to be in error.

If a preliminary examination of the township to be surveyed shows that it contains only a few isolated outcrops of coal beds and no continuous exposures, the geologist locates the outcrops by triangulation and sketches their inferred locations. For the triangulation two convenient land corners are selected from which to begin work, and for a base line the distance given on the land plats is used, it being assumed that this distance has been correctly determined in the land surveys. The corners thus selected are located on a plane-table sheet, and from them other triangulation stations are established over the field and their elevations determined by vertical angles, as already described. After enough points to control the work in the township have been established the geologist makes a detailed examination of the coal. He goes to each outcrop and digs or bores through the bed to learn the thickness of each bench of coal and of each parting and to obtain samples of the coal for study or analysis.

After the bed has been examined and the dip of the strata has been measured the position of the outcrop is located on the plane-table sheet and the elevation determined.

The examination of the coal bed is most important. It must be made carefully and accurately. Each geologist who surveys coal land is told that "every inch of the bed must be critically examined." If the inspection shows that the coal may contain more than the normal percentage of impurities a representative sample is selected and taken to camp, where an ash test is made with a small portable chemical outfit. If there are mines in the area a sample is procured according to the prescribed method (see p. 106) and is sent to the chemical laboratory for analysis. The strata in which the coal is found are also carefully examined to obtain any additional information they may give concerning the depth and continuity of the coal beds where they are covered.

The triangulation method of location described above suffices in areas where there are only a few small outcrops of coal beds, but in townships which contain more than a few outcrops or in which the beds can be traced the outcrops must be accurately located by stadia traverse in addition to the triangulation. If the triangulation and stadia work are done properly, locations should be correct within 20 feet and elevations within 5 feet.

In work of this kind the surveyor traverses the outcrop of the coal bed and with the aid of an assistant and instruments he locates points at short intervals along the line of outcrop and sketches its position between these points. All such locations are tied to land

corners accurately with instruments, and the elevation of each point is ascertained, so that the underground relations of the bed can be determined.

The number of sections measured along the outcrop of the bed depends on the local conditions. If the bed is variable it must be examined at short intervals, but if it is regular the measurements may be made farther apart. Some records show measurements only 50 feet apart, whereas others are half a mile or more, though a shorter distance is recommended. There is no definite number of measurements to the township. In some townships few are made, whereas in others there are as many as a hundred.

At the same time that the geologist is examining the field he procures any information which may have been obtained by miners, prospectors, well drillers, or others making excavations. Such information ordinarily consists of records of wells, drill holes, and mine shafts, mine maps, both exterior and interior, records of production and use, etc., and is of great value in the proper classification of the land.

This method may be applied equally well to materials other than coal if they occur in or in a definite relation to stratified beds, and with modifications it may be and is adapted to less regular deposits of metalliferous minerals. Its chief application, however, in actual Survey practice is in the coal fields of the plains region, where the recent and more accurate Land Office plats are available as bases.

RECONNAISSANCE SURVEY.

Reconnaissance surveys are ordinarily only preliminary and those made for purposes of classification are intended to determine the general distribution of the mineral deposits in areas which have not been described by geologists or which may have been examined only casually or with some other problem in mind than that of discovering minerals of economic value. If no reliable information is at hand concerning an area containing public land, a geologist makes a reconnaissance to determine the best method of work to be followed if minerals are found.

The method of reconnaissance varies with the character of the country to be examined. If the country is suitable for the use of the plane-table method of surveying, the geologist uses that method. He proceeds in the manner already described but on a smaller scale and with less detail. If the country can be readily crossed and little accuracy is required, the geologist starts with an assistant and travels by buggy to the points to be examined. He determines his location from traverses based on hand-compass readings to give direction and on counted revolutions of the buggy wheel to give distance. These traverses are tied to known points wherever possible, and the intermediate locations are adjusted from them. If the country can not be crossed in a vehicle, the geologist goes on horseback or on foot and determines direction as before and distance by counting the number of paces taken by horse or man. This method gives considerable accuracy in location and provides an adequate basis for determining the general mineral or nonmineral character of an area.

State or county maps furnish locations for the geologist on some reconnaissance trips. When working with such a map he starts from a town, post office, or some point shown on the map and proceeds toward some other point also shown. To obtain his location at intermediate points he estimates distance and direction and records his observations with regard to the estimated locations. This method is seldom used, because of its inaccuracy, and it is never used to procure final data for land classification. It was found applicable to conditions in one of the Western States where large areas were withdrawn on the basis of a report that later proved to be erroneous. In this State the general reconnaissance proved the area to contain no coal of value; hence no careful examination was required.

PUBLIC-LAND SURVEYS.

Public-land surveys made by the General Land Office result in the official township maps which are the basis of all land titles and to which, therefore, all data on land classification must finally be adjusted. The system now in use was adopted in essentially its present form in 1785. Under this system a certain initial point is first selected through which a north-south line, called a principal meridian, and an east-west line, called a base line, are run. At successive intervals, usually 24 miles, north and south of the base line standard parallels or correction lines are established parallel to the base, and similarly at intervals east and west of the principal meridian guide meridians are established. Because of the convergence of meridians toward the poles these guide meridians are not parallel to the principal meridian but approach it toward the north. In order to correct this narrowing the guide meridians are offset at each standard parallel and started anew northward at their original distance apart. The quadrilateral thus defined is subdivided into townships, each approximately 6 miles square, and each township in turn is divided into 36 sections 1 mile square. Each section is further subdivided into quarters, and each of these is held to contain four 40-acre tracts, or quarter-quarters, the smallest commonly recognized legal subdivision of the public-land system. Appropriately marked monuments are set at all township and section corners and at the middle points of the side lines of sections, thus indicating the limits of the quarter sections. Posts indicating the quarter-quarters are not set, but this unit, and indeed in special cases smaller units of

10-acre or even 2½-acre tracts, may be recognized in land classification.

This general plan, where properly carried out, is simple and effective and has furnished a satisfactory basis for land records and titles for more than a century and a quarter. Its execution, however, has not in all localities been satisfactory. For a great many years the work was done by contract under State surveyors general, despite the repeated and urgent requests of many Commissioners of the General Land Office for authority to do the work directly. In earlier years the contracts were sometimes distributed as rewards for political services, and the inspections were not always of a character to guard against the acceptance of inadequate surveys. Some of the contracts were obtained by honest men who did their work well, but others fell to inefficient or dishonest contractors who made poor surveys or none at all, although they prepared township plats which were submitted under oath as to their accuracy and which were accepted. In the older fraudulent surveys of this type all sorts of errors and omissions are encountered. In certain localities no monuments can be found and there is every reason to believe that the lines were never run. In other localities the work was done so carelessly that the corner posts are found far from the proper locations. The General Land Office, under the contract system, required that monuments were to be made of stone wherever it could be procured, but the use of wooden posts was permitted in other places. In some localities where advantage was taken of this permission the stakes set were so small or so poorly fixed in position as to constitute merely a nominal observance of the requirements, and many of the stakes thus set have disappeared.

Within recent years the Land Office has adopted the plan of marking corners permanently by deep-set iron posts and has been authorized by Congress to make surveys directly instead of by contract. These modern surveys provide a highly satisfactory basis for land titles, and some of the special surveys made on the Indian reservations by a combination of cadastral and topographic methods are models of complete and satisfactory base mapping.

For purposes of land classification it is imperative that the data procured by the geologist shall be tied to the land net because his classifications must be expressed in terms of the public-land surveys. Furthermore, these identifications must be exact, because it may occasionally be necessary to estimate values of the public lands in tracts of 40 acres, 10 acres, or even 2½ acres. It is obvious that in such cases the land lines must have been accurately run and the corners sufficiently well established to permit undoubted identification. In a few places classification has been impossible because the land lines could not be found and the official surveys could therefore not be identified.

PREPARATION OF DATA FOR CLASSIFICATION.

The geologist, on returning to the office from a field examination of land for the purpose of classification, informally presents to the appropriate section of the board a general outline of his work, the area covered, and the problems met. Thereupon the section decides the particular form of map and report desired. The essential factor in determining in just what form the data shall be submitted is the requirement that all pertinent facts determined by the field investigator shall be recorded and that the finished report shall be as accurate as the field work in location and interpretation. The importance of accuracy and completeness becomes apparent when it is realized that the record once submitted must form the basis not

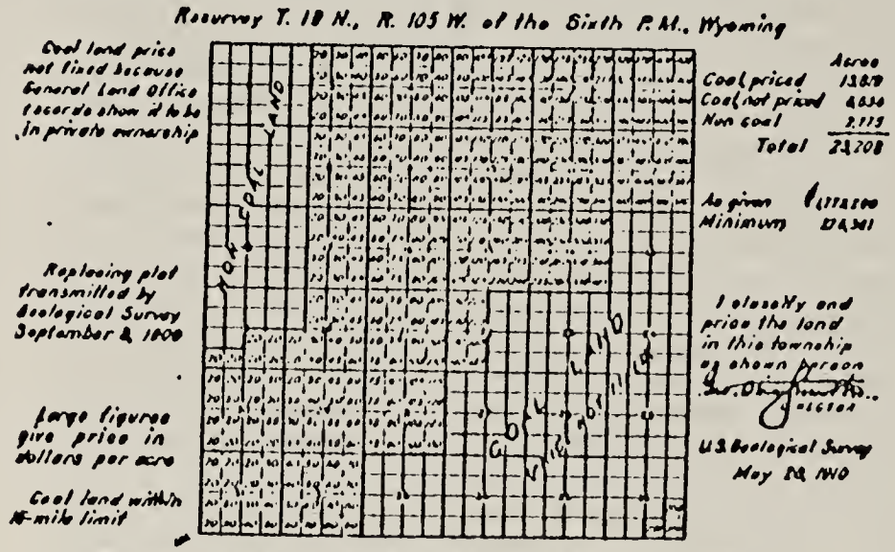


FIGURE 1.—Township map showing classification and valuation of coal lands.

only for the classification of the land as mineral or nonmineral, a classification which may affect the interests of a large number of people, but also, in the case of coal land, for valuations aggregating millions of dollars. As an example, a copy of a township classification and valuation plat as transmitted to the General Land Office is given in figure 1. In June, 1912, private individuals purchased from the Government sec. 12 of this township, for which they paid the classified price as shown, amounting to over a quarter of a million dollars.

In general the data are compiled by the field geologist from his original maps and notes in two forms. The first consists of a small-scale map with an accompanying general report presenting the results of a study of the whole field. In this report the geologist discusses the stratigraphy and structure of the field as well as the oc-

currence of economically important minerals. On the map accompanying this report most of the finer details are omitted and only geologic formations and the outcrops of coal, phosphate, or oil sands are shown. The general report on a field contains a description of all that is known of the physical and chemical properties of the minerals occurring in that field. This report then serves as a basis for a set of general minutes, in which the appropriate section of the board outlines the application of the regulations governing the classification of lands containing those minerals to that particular field. After the general report has been considered by the proper section and the general minutes have been written, the field geologist prepares the classification data and in the case of coal land makes the valuation, under the immediate supervision and with the assistance of some member of the coal section of the board. Later the record is reviewed and passed on in detail by the entire section. Each 40-acre tract, and sometimes even each 2½-acre tract, is considered individually and all facts affecting its classification as mineral or nonmineral are weighed. A report of the proceedings of the section for each township is prepared, giving in detail the result of the classification and the reasons therefor. This report becomes part of the permanent records of the land-classification board.

Detailed reports on each township examined, with accompanying large-scale maps, constitute the second form of data. These are prepared in addition to the general report for all areas on which the smaller-scale map will not suffice for classification. On these large-scale township maps every feature that is possible of cartographic portrayal is represented—the outcrops, dips, and measured thicknesses of all coal or phosphate beds or oil sands, all mines, prospects, or lodes, the location of these features with respect to established land lines, and, if essential, the topography of the surface. Each map is supplemented by a description which gives the dates and methods of field work, the condition of land surveys, the proximity to railroads, and a discussion of the geology. In the valuation of coal land all calculations by which the price per acre for each tract has been derived are given in detail.

These reports and maps are all permanently mounted, arranged in order of State, range, and township in loose-leaf locking binders, and filed in fireproof steel cases. As new information is acquired, from whatever source, with regard to the mineral character of any township, it is added in its proper place in the binder. Such information consists of reports from field agents of the General Land Office, data obtained by members of the Geological Survey on subsequent examinations, affidavits of public-land claimants, and other matter. The original field sheets and notebooks are likewise deposited in the files of the land-classification board and are always readily available for use. Card indexes are maintained covering both sets of files.

COAL LANDS.

PURPOSE OF CLASSIFICATION.

By act of March 3, 1873, Congress provided for the sale of coal lands belonging to the United States, specifying the conditions of sale and the minimum prices. To carry out the act it is necessary to determine, first, what lands are coal lands (classification), and second, at what price they shall be sold (valuation). To give uniformity to Executive action in this work certain rules have been prepared by the Geological Survey and approved by the Secretary of the Interior under the title "Regulations for the classification and valuation of coal lands." These regulations provide exclusively for the classification and valuation of coal lands and are not to be confused with the regulations providing for the disposition of coal lands issued by the Land Office under the title "Coal-land laws and regulations thereunder." It is the province of the Geological Survey to determine what lands are underlain by coal within the limits set by the classification regulations, and to it has also been assigned the work of valuing the lands classified as coal land. Classification and valuation must follow three antecedent steps—(1) the adoption of regulations formulating the principles and practice which are to govern classification and valuation; (2) the field examination to determine the presence, position, quality, and other features of the coal in the land; (3) the assembling of the field data in such form as to facilitate the work of classification and valuation by making possible the simultaneous consideration of all the facts. Finally, classification and valuation involve a consideration of all the known facts to determine what legal subdivisions of land are coal lands under the regulations and at what price they shall be sold.

Preliminary to the detailed consideration either in the field or office of any area believed to contain valuable coals the lands are withdrawn from entry under the authority of the act of June 25, 1910 (36 Stat., 847), as amended by the act of August 24, 1912 (37 Stat., 497). A typical coal-land withdrawal order is appended with the accompanying letter of transmittal:

DEPARTMENT OF THE INTERIOR,
UNITED STATES GEOLOGICAL SURVEY,
Washington, January 21, 1913.

The honorable the SECRETARY OF THE INTERIOR.

SIR: Information on file in the Survey indicates that the land listed below contains valuable deposits of coal, and I therefore recommend the submission to

the President for appropriate action of the following order of withdrawal, involving 1,000 acres.

Very respectfully, GEO. OTIS SMITH,
Director.

JANUARY 28, 1913.

Respectfully referred to the President with favorable recommendation.

SAMUEL ADAMS,
Acting Secretary.

ORDER OF WITHDRAWAL.

Coal-land withdrawal—Montana No. 10.

Under and pursuant to the provisions of the act of Congress approved June 25, 1910 (36 Stat., 847), entitled "An act to authorize the President of the United States to make withdrawals of public lands in certain cases," as amended by act of Congress approved August 24, 1912 (Public No. 316), and subject to the provisions of the act of Congress approved June 22, 1910, entitled "An act to provide for agricultural entries on coal lands," as amended by the act of Congress approved April 30, 1912 (Public No. 141), it is hereby ordered that the following-described lands be, and the same are hereby, withdrawn from settlement, location, sale, or entry and reserved for classification with respect to coal values:

Montana meridian.

T. 8 N., R. 3 E., sec. 25, NE. ¼, S½;
sec. 26, SE. ¼;
sec. 35, E. ½;
sec. 36, all.

WM. H. TAFT,
President.

JANUARY 29, 1913.

METHODS OF CLASSIFICATION.

PRINCIPLES INVOLVED.

In preparing the regulations for classification three principles are paramount: (1) The regulations must be based on demonstrated facts or on well-founded and generally accepted inferences; (2) they must be based on all the stable, permanent factors involved; (3) they must be as definite yet withal as simple as possible. Ideally the regulations should be so simple that anyone at all acquainted with the subject could correctly apply them, and they should be so definite as to admit of little or no disagreement in interpretation. Neither of these ideal requirements can be realized.

The workability of coal at a given point to-day depends on factors of two types. Those of the first type—such as quality, thickness, and depth—are intrinsic; those of the second type—such as railroad transportation and markets—are extrinsic. To-day the extrinsic factors may determine absolutely the commercial workability of a bed of coal at any locality. A coal bed 75 miles from a railroad and 50 miles from the nearest town, no matter how valuable it may be some day, has to-day a value that is purely prospective, depending on an unknown factor—the time when transportation shall

reach it. A new railroad may "make" a coal-mining district by opening new markets or may "break" it by bringing in competition that it can not meet. To be stable, therefore, the regulations must be based directly on the intrinsic factors involved. Tracts classified as noncoal land are disposed of as such without further question as to their content of coal. Classification should therefore anticipate and assume the ultimate coming of conditions favorable for mining and marketing any coal if the coal is otherwise workable.

If an 18-inch coal of a certain grade occurring under certain conditions is workable in Missouri to-day, hundreds of thousands of tons being mined yearly, it would appear to be a reasonable assumption that a coal of like thickness and quality occurring under similar conditions elsewhere will be workable some day and should therefore be classed as a workable coal; especially does this assumption appear reasonable when it is considered that everywhere the tendency is to extend the limits of workability. Coal mining has nearly always been conducted on a very close margin. In any new field—and most of the coal fields of the West to-day are now—only the most accessible, thickest, and best of the coal beds can be worked at a profit. Twenty years hence the most accessible coal will have been largely mined out and mining will be done on coal that is a little less accessible and that costs a little more to mine and that necessarily will sell at a little higher price. This higher price will permit the mining of other coal—a little thinner and a little poorer—which could not be mined profitably to-day, and the process will continue until all coal within minable limits is exhausted. The regulations attempt to define what these minable limits are, not in view of the conditions that may exist as the coal supply approaches absolute exhaustion, but in view of actual practice to-day under favorable conditions of transportation and of market.

FACTORS INVOLVED.

ESSENTIALS OF WORKABILITY.

The workability of any coal will ultimately be determined by two offsetting factors—(1) its character and heat-giving quality, whence comes its value, and (2) its accessibility, quantity, thickness, depth, and other conditions that affect the cost of its extraction. It must be considered a workable coal if its value, as determined by its character and heat-giving quality, exceeds the cost of extraction, either as judged by actual experience at the point where it is found or as judged by actual experience on similar coals similarly situated elsewhere. There are no absolute limits to any of the factors. The mining of 1 inch of coal that may involve the mining of 8 feet of rock is physically possible but would not pay. Most unworkable coal beds

lack one or more of three things—quality, thickness, accessibility—that is, they are too poor, too thin, or too deep. Other things—such as poor roof, gas, water, faults, pitch, and lack of timber—may render mining difficult and temporarily unprofitable, but most or all of them are subject to engineering control. They may depreciate the value of the coal and defer its mining but may not make it unworkable.

QUALITY.

Coal is essentially a fuel. The heat afforded by burning coal is derived mainly from its carbon and the hydrogen that is free to burn. Associated with these are oxygen, nitrogen, water, and ash. A pound of the best coal, which contains about 90 per cent of carbon and "available" hydrogen and 10 per cent of the other ingredients, will yield from 14,000 to 15,500 British thermal units. A British thermal unit ("B. t. u.") is the amount of heat required to raise the temperature of 1 pound of water 1° F. under certain standard conditions. Poorer coals contain larger percentages of noncombustible constituents and correspondingly less carbon and available hydrogen, and their heating value (in British thermal units or other units of measurement) is reduced in much the same ratio. On analysis some coals show a content of all impurities that is in excess of the average; others show an excess of ash or water only; but whether the increase is in ash or water, or both, its effect is to decrease the heating value of the coal as expressed in B. t. u. Instead, therefore, of specifying the maximum quantity of ash or water allowable in a commercial or salable coal the regulations fix a minimum value in B. t. u. which will cover either one or any combination of these two or any other impurities. The limit of allowable impurity in a salable coal is affected by the facts that very wet coals may be improved by air drying and that coals which are very high in ash may usually be improved by washing or may, perhaps, be used in a producer-gas plant. The possibility that improvements may be devised in the utilization of coal—such as its entire utilization at the mine for producing electric power—makes the determination of the lowest limit of usable quality of coal difficult and very uncertain. Again, in a study of the B. t. u. value of low-grade coals that are now worked, difficulty is encountered in the fact that many of the earlier samples taken were weathered coal. On account of the possible improvement of the quality of the coal by drying or by washing, the lowest limit of usable quality is fixed by analysis of an air-dried sample, and if the coal as obtained in the mine contains a very high percentage of ash the possibility of its being washed is considered. Analyses of samples of coal cut in the mine from unweathered coal, according to the practice of the Geological Survey and the Bureau of Mines, indicate that any coal mined commercially in the United States to-day will yield, after being washed or air dried, at least 8,000 B. t. u. This figure has therefore been fixed as the minimum B. t. u. value of any coal that shall be considered workable. In practice the washed product of any coal subject to washing must have at least 50 per cent of the weight of the unwashed coal. The washability of any coal is determined on a sample of one-quarter inch size by a float and sink test, the liquid used having a specific gravity of 1.5. Even if its workability is thus indicated in the laboratory it can not be considered workable unless there is sufficient water in the field for washing it.

THICKNESS.

More coal is unworkable because it is too thin than for any other reason. The result of a study of the relative cost of mining in relation to the thickness of beds is given on pages 83–86.

For the purpose of classification a careful study was made of the thicknesses of coals that are actually mined in a large commercial way. Many of the facts disclosed by this study have been published.[1] By platting these with reference to the B. t. u. content of the coal it became evident that in actual practice coals yielding 10,000 B. t. u. are worked with profit down to a thickness of 18 or 19 inches, that coals yielding 12,000 B. t. u. are worked down to 14 or 15 inches, and that better coals are mined from beds still thinner. Some coals of the qualities mentioned are mined from beds that are thinner than those noted above, but under very exceptional conditions. In considering the low-grade coals three special factors must be noted: (1) Most of them occur in rocks of more recent age than the others, which have been less affected by mountain-making forces and are therefore less indurated. On this account it is thought that future extensive mining may show the frequent necessity of leaving some of the coal for roof and of leaving larger pillars. (2) Owing to the air-drying loss in very wet coals they are likely to shrink considerably before they are marketed. (3) If the low B. t. u. value of these coals is due to their high content of ash an allowance should be made for loss in washing. For these reasons the minimum thickness for beds of the low-grade coals is not much higher in proportion to B. t. u. value than for beds of coals of higher grade.

The minimum minable thickness of bed is fixed at 14 inches for all coals having more than 12,000 B. t. u. For coals having less than 12,000 B. t. u. the minimum minable thickness increases at the rate of one-tenth inch for each decrease of 100 B. t. u. down to 11,000, then at the rate of one-tenth inch for each 50 B. t. u. down to 10,500, then at the rate of one-tenth inch for each 25 B. t. u. from 10,500

[1] Fisher, C. A., Depth and minimum thickness of coal beds as limiting factors in valuation of coal lands: Bull. U. S. Geol. Survey No. 424, 1910, pp. 56–63.

down to 10,000. The increase for coals yielding less than 10,000 B t. u. is at the rate of one-tenth inch for each decrease of 10 B. t. u. in the coal. The following table gives the thicknesses for B. t. u. of even five hundreds:

Minimum thicknesses for even five hundreds B. t. u.

B. t. u.	Inches.	B. t. u.	Inches.	B. t. u.	Inches.
15,000	14	13,500	14	10,000	18
14,500	14	13,000	14	9,500	22
14,000	14	12,500	14½	9,000	28
13,500	14	12,000	15	8,500	33
13,000	14	10,500	16	8,000	36

An important question that frequently arises is, What value, in relation to thickness, shall be given to split or broken beds? The general practice of the United States Geological Survey in classifying coals has been to give a split bed the value of an unbroken bed with which it can fairly be compared. It is evident that a solid 8-foot bed is worth more than two 18-inch benches separated by 6 inches of clay or shale. After careful study the Survey adopted the simple expedient of prescribing that any parting or bench of bone or impure coal included in a bed injured the value of the coal of the bed in amount equal to the thickness of the parting. Thus the split bed just cited, with its 6-inch parting, is regarded as equivalent to a solid bed 30 inches thick (36 inches of coal minus 6 inches of parting equals 30 inches). If the benches on either side of the parting are not of the same thickness the thickness of the parting is deducted from the thickness of the thinner bench. It is not necessary to consider the whole thickness of a coal bed. It is the practice of the Survey to start with the best bench, if in itself not of workable thickness, and to add the thickness of the next bench above or below after deducting the thickness of the intermediate parting. If the whole bed thus included is still not of workable thickness and more benches exist above or below, the thickness of these benches is added, after subtracting the thickness of the parting between them and the principal bench. If a parting is thicker than the thinner adjoining coal bench, that bench is considered as having no value. This practice is best illustrated by a group of concrete examples. (See fig. 2.)

As a matter of practice two coal layers, each workable, are treated as parts of a single bed if the two layers both exceed in thickness the parting between them and the parting does not exceed 8½ feet. In general two layers of coal are treated as two beds if the parting between them exceeds either one in thickness, and their workability is determined on that basis.

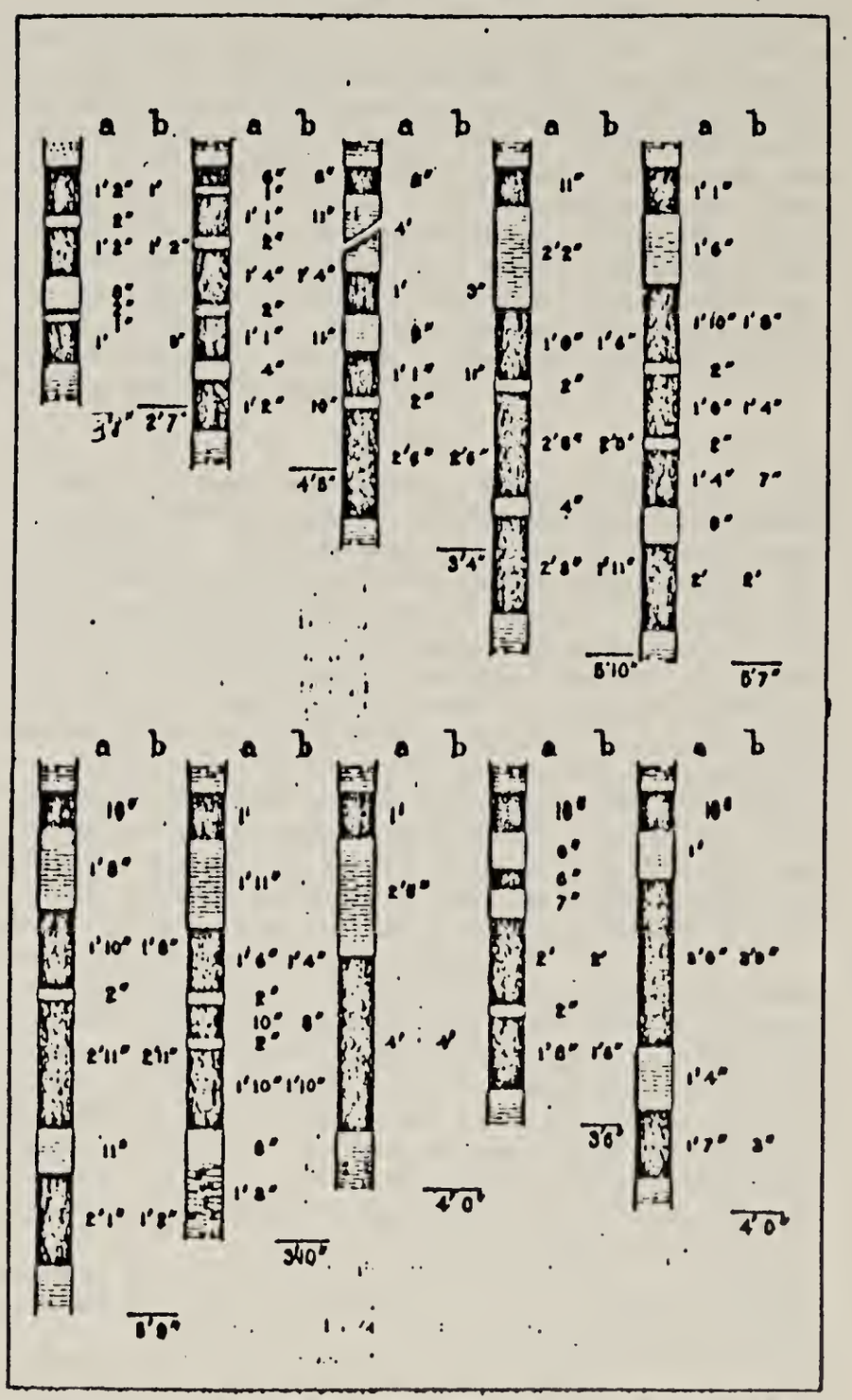


FIGURE 2.—Diagram showing split or broken beds and their value for classification: a, measured thickness; b, equivalent thickness used in classification and valuation.

The criteria given in the preceding paragraphs are intended to determine the workability or nonworkability of a coal measured at any given point. The most difficult problem in classification is the determination of the probable limits of workability of an irregular coal. Coal occurs in beds ranging in thickness from a fraction of an inch to 100 feet or more and in areal extent from a few square feet to thousands of square miles. Some beds maintain a nearly uniform thickness over hundreds of square miles. Others may be traced at the same geologic horizon over hundreds or thousands of square miles but vary greatly in thickness, ranging from a few inches to several feet or back again within a quarter of a mile. Every grade of regularity or irregularity between these extremes is found, and it is possible to determine the "habit" of some beds as regards regularity.

The simplest problem is that in which two unequal measurements on a single bed, taken at different places, are available. All such beds are assumed to grade uniformly in thickness from the thicker measurement to or through the thinner measurement, and a limit to the workable coal is thus fixed that, while it may or may not agree with the unknown facts, is the most probable limit. In general, a coal bed that can be traced continuously along the face of a cliff, as can many beds in the West, has usually been assumed to extend under the land back from the cliff at least one-half the length of the cliff outcrop, the lens or bed having the shape of a half-circle, the length of the cliff outcrop being the diameter of the circle. Obviously, if the outcrop runs along the cliff for many miles, the extension of the coal back from the outcrop may be modified by many other factors, such as limit of depth, or outcrop on the opposite side of the hill. If the bed outcrops along the cliff with irregular thickness, only a moderate extension of the bed behind the cliff is assumed, the estimate being based on the character of the irregularities shown by measurements made along the cliff, or by a general knowledge of the extent of the lenses of that particular coal or of coals of that group, and depending on the general "habit" of the bed, if known, and also taking into account all local features. If the exposed outcrop does not extend in a straight line, but, as is more common, runs in and out of ravines, careful note is made of the thickening or thinning of the coal between one point of measurement and another in order to detect, if possible, any general tendency of the bed to thicken or thin in any direction, and all these measurements and tendencies are taken into account in determining the probable extent of the lens in any direction.

Many beds studied are known to be of less than workable thickness in larger or smaller part, and any measurement showing a workable thickness on such a bed must usually be considered as a measure taken at the center of a small lens of workable coal. A discovery

or measurement of a coal bed by a well, or by drilling, will have the same value as an isolated measurement on the outcrop. The content and shape to be assigned to any lens must depend on conditions and are largely matters of judgment, and such assignments or determinations especially require a wide knowledge of coals and of the particular group of coals to which the bed under consideration may belong. To insure uniformity in treating the thousands of questions of this kind that may arise—for nearly every field involves some, and many fields involve a great number—the Geological Survey has gradually established a series of precedents, and in every question the attempt is made to reach conclusions by means of mathematical calculation. The limits of this bulletin will not allow the consideration of these methods here.

DEPTH.

Some of the facts about the deep mining of coal in this country and abroad have been presented and discussed in an earlier bulletin of the Survey.[1] Not many years ago it was the common opinion and practice in parts of the West to consider as coal land only land on which coal actually cropped out, and requests are still occasionally sent to the Geological Survey asking the reclassification of certain land that had been previously classified as coal land, the writers contending, and supporting their contention by abundant affidavits, that the land is noncoal, because no coal shows at the surface and none has been found on it in wells. If such land should be considered noncoal land, however, most of the coal now mined in Illinois, Indiana, western Kentucky, Michigan, Kansas, and some other States comes from noncoal land, for most of the mines in those States are on lands where the coal mined does not crop out but is reached by shafts. The actual outcrop of most of the coal mined in these States is from 5 to 75 miles away from the shafts.

Two questions are here involved: (1) How deep can coal be mined? (2) Can all coals be mined to the same depth? Coal is now being mined to a depth of practically 4,000 feet (3,937 feet), and many shafts in England, Belgium, France, and Germany go deeper than 3,000 feet. Moreover, a consideration of the still greater depths to which substances other than coal are being successfully mined and a study of the deepest coal mines have convinced many of the best engineers of England and Europe that coal mining will be extended to 5,000 feet.[2] The fact also that some of the largest coal companies of this country have purchased as coal land certain tracts under which the coal is believed to lie at depths of 5,000 to 6,000 feet

[1] Fieber, C. A., Depth and minimum thickness of beds as limiting factors in valuation of coal lands: Bull. U. S. Geol. Survey No. 424, 1910, pp. 48 et seq.
[2] Idem, p. 51.

shows that some American engineers believe that coal mining will be carried to those depths.

Although, without regard to profit, there may be a physical limit to the depth that coal can ultimately be mined, in general the depth of mining must be determined by its cost. Given a steady market the depth to which coal can be mined is a question that involves diminishing profits; every added foot of depth adds to the time required to lift the coal, thus reducing the possible output of the mine, to the cost of the lift, to the initial capital required and the interest on that capital, to the size of pillars, and to other factors. Where coal is mined at a certain depth with a narrow margin of profit, obviously mining at a much greater depth will extinguish that margin and render that coal unworkable until markets are better. Of two coals at the same depth, of the same thickness, and in other ways equal but of different quality, one, the better coal, may yield a profit and the other may not. A similar inequality of profit may exist between two coals of the same quality but of different thickness. The thicker coal, which can be mined at a less cost, may be minable at a profit, while the thinner may not. In brief, the depth to which any coal can be worked depends, on the one hand, on its quality, which determines the profits where the cost of working is the same, and, on the other hand, on the cost of mining, which, omitting differences due to depth, is in general proportional to the thickness of the coal. Therefore, given a certain grade of coal which sells on the market at a certain price the profit will be in inverse ratio to the cost of mining, and hence, other things being equal, the depth to which that coal can be mined will differ for different thicknesses of coal and is assumed to vary in direct proportion to the value of the coal as computed from the cost of mining.

The depth to which any coal can be mined is therefore assumed to be directly proportional to the B. t. u. value of the coal and inversely proportional to the cost of mining for different thicknesses. Thus below the adopted minimum depth of 500 feet, a 10,000 B. t. u. coal can be mined to only two-thirds the depth of a 15,000 B. t. u. coal, and an 8,000 B. t. u. coal to two-thirds the depth of a 12,000 B. t. u. coal of the same thickness. If 5,000 feet is assumed as the maximum possible depth at which any coal can be mined, it is also assumed to apply only to coal of the highest grade and to the thickness costing the least to mine—in other words, to a 15,000 B. t. u. coal 6 feet or more thick. By this assumption a 6-foot coal of 12,000 B. t. u. is considered as workable to only 4,000 feet or a 6-foot coal of 10,000 B. t. u. to only 3,333 feet.

Elsewhere in this bulletin it is pointed out that the cost of mining a ton of coal is much higher for thin beds than for thick beds. There is no great difference in the cost of mining coals between 6 and 10 feet thick, but, especially in the West, the cost of mining coals less than 6 feet thick increases as the thickness decreases. It has therefore been assumed that a coal of the minimum thickness for its grade is workable to a depth of not more than 500 feet; that a coal 6 feet or more thick is workable to a depth of 100 feet for each 300 B. t. u. it contains; and that a coal between its minimum thickness and 6 feet is workable to a depth between 500 feet and the maximum depth limit for that coal proportional to the thickness above the minimum. Thus, a 12,000 B. t. u. coal 6 feet or more thick has a maximum depth limit of 4,000 feet and an assumed minimum thickness of 14 inches; a bed of 12,000 B. t. u. coal 4 feet thick is workable to a depth determined by the rule above given as follows: 72—14 : 48—14 :: 4,000—500 : x; x=2,050, which added to 500, the depth limit for a bed of the minimum thickness, gives 2,550 as the depth limit for the bed under consideration.

The accompanying chart (fig. 8) is copied from part of a large-scale diagram used by the Geological Survey in classifying coal land. It is arranged to show the depth limit fixed for a coal of any B. t. u. value of any thickness under 6 feet.

For convenience the readings for the even feet and for the even thousand B. t. u. are given in the following table:

Limits of minable depth of coal of various thicknesses and various heating values in B. t. u.

British thermal units	15,000	14,000	13,000	12,000	11,000	10,000	9,000	8,000
Thickness, in feet								
1½	811	787	764	741	964	800	.....	.....
2	1,278	1,217	1,160	1,100	1,040	828	.....	.....
3	2,200	2,078	1,950	1,830	1,668	1,440	600	.....
4	3,140	2,940	2,740	2,540	2,340	2,078	1,800	1,140
5	4,070	3,800	3,540	3,270	3,010	2,700	2,330	1,920
6	5,000	4,666	4,330	4,000	3,666	3,330	3,000	2,666

In general the limit of depth at which a coal bed may be profitably mined depends entirely upon the thickness of the bed and the quality of the coal. If, however, a thin but workable bed that lies below its ordinary minable depth is overlain by a thicker bed that lies within its own minable depth, the lower thin bed may, perhaps, be profitably worked by extending downward the shaft sunk to the higher, thicker coal, whereas the thinner bed could not have been profitably mined alone. A single shaft may also give access to all the coals of a group, and, though the cost of raising all the coal will be the same as if the coal were taken from a single bed, the cost of the shaft and the interest on that cost will be borne by the proceeds of a larger product. In some places the whole cost of a shaft may be borne by the coal of a thick bed that underlies several thinner beds

or that lies in the middle of a group of thinner beds. It is clear that no two shafts that penetrate groups of coal beds will present

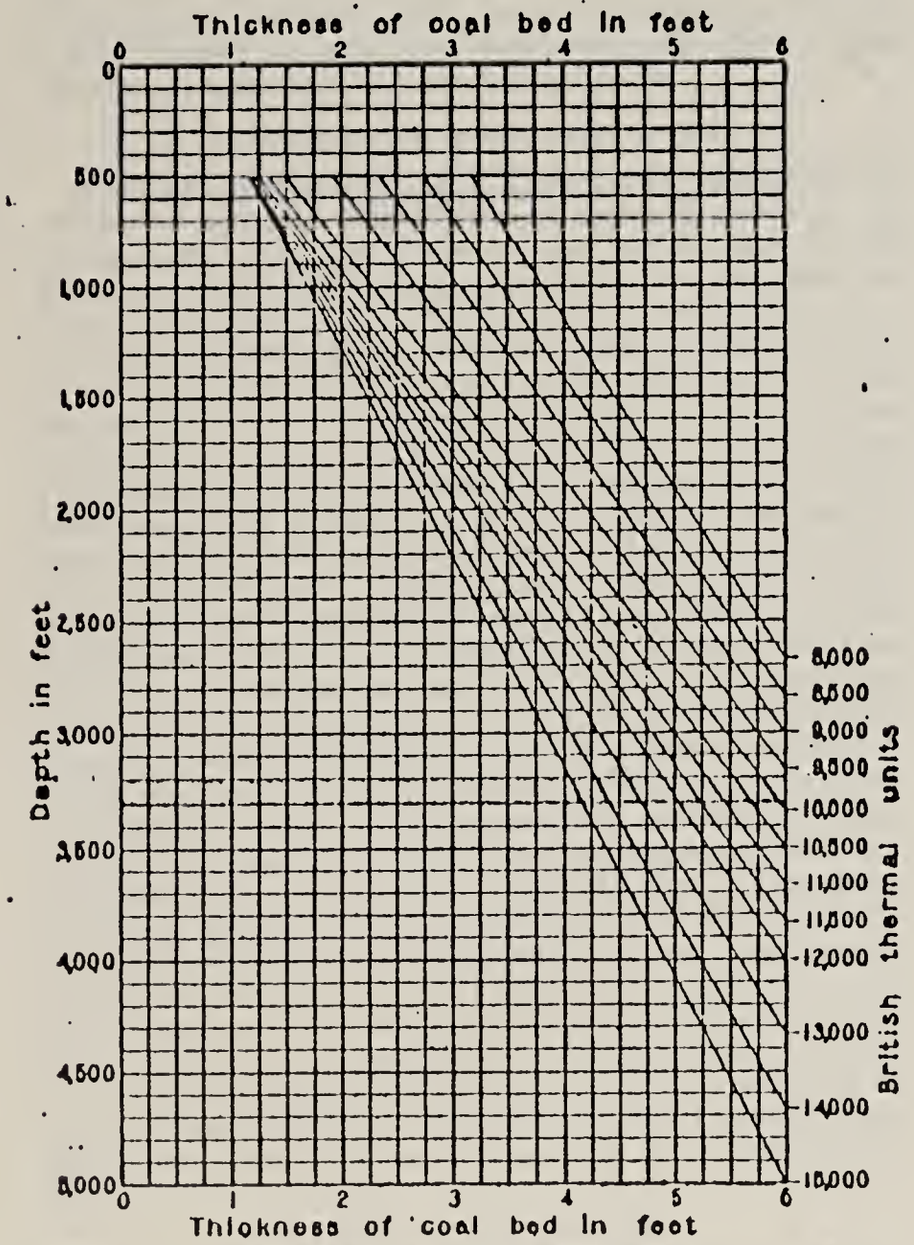


FIGURE 3.—Diagram showing depth limits of coals of different B. t. u. and of different thicknesses under 6 feet.

similar conditions. The coals of such groups will vary in number from two to twenty or more and may be included in an interval

of 50 to 500 feet or more. Every case involving such conditions must be considered on its merits, and here again the Geological Survey has found it necessary to establish a series of general precedents in order to make its treatment of such cases reasonably uniform. In some places it has been found possible to treat a group of coal beds as if they were all gathered at a "center of weight"—that is, at a point determined by multiplying the computed thickness of each bed by its depth from the surface and dividing the sum of the products by the sum of the compensated thicknesses, the thicknesses of the various beds being reduced for partings in the manner already described.

The determination of the limit in depth at which a coal bed can be mined may be complicated by the fact that in a region of very rugged topography the coal gets below minable limit in passing under some high ridge or peak but is within the minable limit under a valley on the other side. Again, in some places the coal outcrops near the foot of a great cliff, such as commonly flanks a high plateau in the West, and it goes below minable depth within a short distance from its outcrop. In order to cover all the different occurrences of this kind the regulations provide that tracts underlain by horizontal beds of coal that lie at depths below the minable limit may under certain conditions be classified as coal land. Horizontal beds of coal may be mined to a distance back from their outcrop equal to 10 times the depth limit for coal of that particular grade and thickness. It is evident that, to be commercially minable at a certain depth, a coal bed must be minable for a reasonable distance from the foot of a shaft sunk to it, in order to pay the cost of the shaft. It is also evident that if it is profitable to sink a shaft to the depth limit for a given coal and then mine out horizontally by drift a certain distance from the foot of the shaft, it would be profitable to mine farther from the foot of the shaft if it were not so deep. The relative values involved in shaft and drift can be easily calculated if unit values are fixed for the horizontal and vertical components. For purposes of classification and valuation it has been assumed that 1 foot of vertical shaft in rock involves as much expense in its construction and maintenance and in the removal of the coal as 7.5 feet of horizontal drift in coal. For this reason the horizontal distance to which the drift can be carried will be no more than the prescribed limit for mining from the outcrop (in this case set at 10 times the vertical limit) minus 7.5 times the depth of the shaft. Thus if the minable depth of a certain coal bed is 2,000 feet, but that bed is horizontal and crops out in a cliff, the area underlain by it is classified as coal land for a distance of 10 times 2,000, or 20,000 feet, back from the outcrop. If the bed is horizontal but lies at a depth of 700 feet, it is assumed that the coal can be mined back 20,000 minus $(700 \times 7.5) = 14,750$ feet from the

foot of a shaft of that depth, even if, away from the foot of the shaft, the coal is more than 2,000 feet below the surface. If the shaft is 1,200 feet deep the coal can be mined back 20,000 minus (1,200×7.5)=11,000 feet. If the coal is at the depth limit at the foot of the shaft it can be mined back 20,000 minus (2,000×7.5)=5,000 feet, or approximately 1 mile in any direction.

CLASSIFICATION BY 40-ACRE TRACTS OR LOTS.

In ordinary practice coal land is disposed of by parcels composed of "smallest legal subdivisions," which are ordinarily quarter-quarter sections, or 40 acres, except along the north and west sides of townships and in areas bordering meandered rivers or lakes, where the tracts are usually irregular in size and shape and are called lots.

The price of a tract that is wholly underlain by coal is the price per acre multiplied by the number of acres. The price of a tract that is only in part underlain by coal is the price of the coal per acre multiplied by the number of acres it underlies. To obtain the sale price per acre of the 40-acre tract or lot, the amount obtained by the above computation is divided by 40 or by a figure representing the actual acreage, but no land must be appraised at a price below the minimum fixed by law. Thus if 24 acres of a 40-acre tract is underlain by coal valued at $50 an acre the price of the "forty" is 24 times $50=$1,200, or $30 an acre ($1,200÷40=$30). The value of the coal in some lands, however, is so small that to charge even the minimum price for them would make the price of the coal abnormally high. For example, to take an actual case; Five acres of a 40-acre tract is underlain by coal 2 feet thick, the total value of which under the regulations is about $100. The tract is within 15 miles of a railroad, and therefore if it is all sold as coal land it must be sold at the rate of $20 an acre—that is, the whole tract must be sold for $800. The coal land in the forty is therefore segregated from the agricultural land, the line of division following the 10 or 2½ acre subdivision. The two portions of the forty thus segregated are treated as separate lots. The 5 acres of coal land is sold for $100, its value, and the noncoal tract is subject to disposal as nonmineral land. Such a division of the forty into two lots, one coal and the other noncoal, is made only along the outcrop of the coal and only within so short a distance from known corners that little doubt can arise as to the exact position of the outcrop.

OUTCROP COAL AND BURNED COAL.

In coal-mining practice it has been found that the coal along the outcrop and for a distance back of it ranging from 30 to 100 feet or more, the distance depending on the amount of cover, is more or less influenced by weathering, which materially decreases its value. Difficulty due to the thin and weak roof is also encountered in mining on the outcrop. If only a thin edge or corner of coal extends into a forty it may be neglected, as it will give the tract no value as coal land. If the coal outcrops in bluffs or steep hillsides or has a high dip weathering may be neglected. If the coal outcrops at the top of a mesa or on the face of a long, gentle slope an allowance is made for thinness of cover. The possibility of mining outcrop coal by stripping with steam shovel or otherwise is generally considered, as such a method of coal mining has in many places proved highly successful.

In many areas of the West the coal beds have been burned along the outcrop. In some places one or more or all of the beds have been burned not only along an outcrop over a whole field but under the flat tops of mesas where the coal is close to the surface. In a few places mining has shown that this burning extends back 1,000 feet or more and lies many hundred feet under cover. In general, however, the coal does not appear to have burned back more than a few rods. All places where coal has been burned are indicated on the field maps. In classifying the land in these places the edge of the coal is fixed along a line drawn back of the outcrop, only slightly back of it where the line crosses ravines, but to a considerable distance back of it where it crosses projecting divides, especially if the coal is under light cover.

METHODS OF VALUATION.[1]

COST OF COAL IN THE GROUND.

The total cost of coal in the ground consists of the original purchase price, interest on investment, amortization charges, taxes, and, if the coal is leased, the cost of inspection and of collecting royalties. The following table shows the amortization and ultimate cost of coal in the ground per dollar of investment for periods ranging from 20 to 40 years, at 5 and 6 per cent interest.

Ultimate cost of coal per dollar of purchase price.

Amortization period in years.	Rate of interest.	Annual interest.	Annual taxes at 1 per cent.	Annual amortization charge.	Total annual cost.	Total cost per dollar of purchase price at end of amortization period.
	Per cent.					
20	5	$0.05	$0.01	$0.03	$0.09	$1.80
	6	.06	.01	.027	.097	1.94
30	5	.05	.01	.018	.078	2.34
	6	.06	.01	.0126	.0826	2.478
40	5	.05	.01	.005	.065	2.60
	6	.06	.01	.006	.076	3.04

[1] For a more detailed account of the principles of valuation of public coal land see Survey Bulletin 624, on the valuation of public coal lands.

It is generally agreed that the price paid for coal in the ground should be recovered by the investor during the early years of the mining, when the cost is lowest. Otherwise it must be recovered when the inevitable increase in the cost of working the mine has reduced the profits and the business has reached a condition that is the bane of the eastern coal-mining industry to-day. The initial investment should invariably be refunded within the first 20 years of the life of the mine. The above table shows that if the mine is opened and operated immediately and continuously after purchase the total cost of the coal in the ground will be about two dollars for each dollar of the purchase price. The value of coal in the ground at the time of its extraction is measured by the current royalty rate in the region where the coal is situated. Its value at the time the mine is opened is, then, approximately one-half the royalty rate, as has been indicated. Were it possible to know in advance the exact number of tons that would be recovered from any acre of land, the value of that acre at the beginning of mining would be one-half the royalty rate per ton multiplied by the tonnage recovered. If the royalty rate is 10 cents a ton, the value of coal per ton in the ground when a mine is opened is at least 5 cents. To insure profit and safety, however, the purchaser of coal land, as a rule, in buying demands a margin on the estimated tonnage value (1) as a consideration for the risk of the investment, (2) to offset possible delays in the mining of the coal, and (3) as a contingent against an overestimate of the recoverable tonnage. If this margin is fixed at one-half the estimated value, the coal should have a sale value of 2½ cents a ton if the royalty is 10 cents a ton. Royalties on bituminous coals in the United States range from about 3 to the equivalent of 35 cents a ton. A comparison of royalties paid in the United States, some of which are given in Survey Bulletin 424 (p. 10) shows that 10 cents a ton is not far from the average royalty paid under private leases—somewhat less in the East, somewhat more in the West. Therefore 2½ cents a ton is a fair sale price for unmined coal that is to be mined immediately, where 10 cents a ton is the prevailing royalty. As a matter of fact, where the character and tonnage of the coal are well known to both buyer and seller prices often range from one-quarter the royalty rate almost or quite to the royalty rate. For example, the Pittsburgh coal, in southwestern Pennsylvania, is worked to a thickness of about 7 feet. On an estimate of 1,200 tons recovery per acre-foot this bed should yield 8,400 tons an acre; yet it is reported that 99 separate transfers were made in Westmoreland County between 1901 and 1910 at an average price of $1,102.70 an acre—over 13 cents a ton—and many of these sales were made at a price much higher than this average. Occasionally the sale price for small tracts adjacent to operating mines may reach the royalty rate.

The general impression that coal lands are sold at low prices is due largely to the fact that in the past most of the sellers had bought their land as farm land, knowing little or nothing of its coal content or value, and had regarded the coal as a little overmeasure on the part of nature for which they were willing to take anything that was offered or that looked good to them. As a result a large number of the recorded sales of coal land have been made at prices that have had little relation to the value of the coal, and in the past a large percentage of the total acreage has been sold at such prices. A recent review of coal-land sales for one year, as recorded in one of the most reliable of the coal journals, excluding all sales of tracts containing over 10,000 acres, which were obviously bought for holding or speculation, showed 40 sales, representing a total of 95,218 acres, at an average price of $209 per acre. This average price for a year's sales shows the great extent to which coal lands have passed out of their original farmer ownership. Grouped according to prices, it is found that that year's sales as thus recorded ran as follows:

Prices of coal lands sold in one year.

Price per acre.	Sales.	Acres.
$400 or more	8	10,199
$300 to $400	3	1,433
$200 to $300	4	417
$100 to $200	8	14,046
Less than $100	13	26,097
	14	82,817

In other words, 65 per cent of the sales and the acreage were at $100 an acre or more and 40 per cent of the sales were at $200 an acre or more.

It is evident that a large share of these were sales of lands not purchased for immediate development. Sixteen of these sales, conveying 74,633 acres, covered tracts containing more than 1,500 acres, an area generally admitted to be as large as can be economically mined from one plant in present-day practice.

In order to give the prospective buyer an ample margin of safety, the basing prices of the Government coal lands are fixed at only 40 per cent of the value (2½ cents per ton) named in a preceding paragraph, or at 1 cent per ton for a coal of good average quality—say 12,500 B. t. u.—equivalent to one-tenth of a cent for each 1,250 B. t. u. of the coal. This price is one-tenth the assumed average royalty rate.

FACTORS INVOLVED.

The valuation indicated, however—1 cent per ton for coal in the ground—is not put on all coals indiscriminately. Though the value of any coal is most readily obtained by taking the royalty rate,

the royalty rate itself is based on the average difference between the cost price of the coal ready for sale and the sale price—that is, on the profit. If competition is keen and the profit is low, these facts are reflected in a low royalty rate. Whatever affects the profits affects the royalty rate and correspondingly the value. Other things being equal, the lower the grade of coal the less readily it sells and the less the profit, the royalty, and the value. On the other hand, the more expensive the coal is to mine the less the profit, the royalty, and the value. The Government valuations can not take account of changes in competition, markets, transportation facilities, or freight rates, or other factors that affect the profit, but it can and does take account of the quality and character of the coal, both chemically and physically, which affect the sale price and so the profit and value, and of those natural factors that affect the mining cost. The most important of these factors are thickness and accessibility.

EFFECT OF QUALITY ON PRICE

One cent per ton is therefore the price put on a good average coal—a noncoking bituminous coal of 12,500 B. t. u. heat value, 6 to 10 feet thick, and at the surface. For coals of other B. t. u. value the same rate of one-tenth cent for each 1,250 B. t. u. is applied, and provision is made for increasing this value (not to exceed 100 per cent) for coking coal or coal that has special qualities which enhance its value in the market, the percentage of increase depending on the quality of the coke it yields or the extent to which its special qualities enhance its value; and on the other hand provision is made for reducing the appraised value because of special impurities, such as sulphur, or because of physical defects that obviously detract from the market value.

EFFECT OF MINING COST ON PRICE

The cost of mining coal is affected by many factors—such as cost of prospecting, shaft sinking, or other mine opening, surface and underground plant, perhaps community plant, water, supplies, timber, feed, and insurance—all of which vary from place to place or in accordance with the method of working the mine. Within the mine the main factors are mining rate, thickness, depth, and dip or pitch of bed, variations or irregularity in thickness, partings, "sulphur" or other impurities that must be removed, kind of roof or floor, presence of gas or water, provision for drainage and ventilation, haulage and hoisting, faults, and igneous intrusions. Many of these factors give rise to problems for the engineer; others definitely affect the value of the land for coal mining. One of the factors of the latter class—thickness—has so definite and constant a relation to the cost of mining that it must be taken into account in determining the value of all coal land.

VALUE OF THIN COALS

The cost of mining thin coals increases rapidly with the decrease in their thickness, for the following reasons: The rate paid for mining the coal increases with the thinning of the bed, as do the amount of dead work per unit of output, the cost of trackage, ties, rails, haulage, and ventilation, and, for the very thin coals, the cost of taking up floor or brushing down roof to obtain height.

H. M. Chance[1] has prepared curves expressing the relations between mining cost and thickness for anthracite coal. The figures showing Chance's determinations are given in column 2 of the table on page 84. Similar figures (column 3) were obtained by the Survey for bituminous coals. Detailed cost sheets of mines working coals of different thicknesses were taken and the costs were separated into four items—(*a*) capital cost (interest, etc.); (*b*) mining rate; (*c*) tonnage cost (proportional to output, tipple, office, etc.); (*d*) acreage cost (proportional to acreage mined out, dead work, hauling, etc.). Obviously, if the recovery per acre-foot is the same, the last item would be double for a 5-foot coal bed what it would be for a 10-foot bed yielding the same output and would be inversely proportional to the thickness of the bed. Though the tonnage recovered is greater per acre-foot from thin than from thick beds, yet the recovery varies so greatly from mine to mine and from time to time that an absolutely invariable recovery from a bed of a given thickness can not be assumed. Therefore, in reaching the results now to be stated, differences in recovery from beds of different thickness have not been considered. As in all studies of coal mining made by the Geological Survey the obtainable figures relating to any particular factor were, if possible, gathered together and platted graphically on a chart, by which it has usually been practicable to show certain definite averages or curves expressing the relation sought. Whenever possible, these curves have been reduced to mathematical formulas. A concrete example is a curve showing the relation between the mining rate and thickness of bed, a relation which it was necessary to determine in working out the total cost of mining beds of different thicknesses. In making this diagram the mining rates at different places in the United States were platted on cross-section paper as shown in figure 4 (p. 85), on which the curve A–B was drawn to express the average relation between these two factors, a relation which was used in later computations.

[1] Chance, H. M., The cost of mining coal: Eng. and Min. Jour., May 30, 1908, pp. 1099–1101.

The following table gives the derivation of the formula showing the relation of the thickness to value of bed, uniform recovery being assumed:

Table showing derivation of formula for relation of thickness to value of bed.

Thickness of bed in feet (t).	Average cost.		Approximate combination cost.	Value by inversion.	Difference—10 minus thickness in feet.	Square of amount in column 6.	100 minus amount in column 7.
	Anthracite (Chance).	Bituminous.					
1	2	3	4	5	6	7	8
10	1.00	1.00	1.00	1.00	0	0	100
9	1.01	1.03	1.02	.97	1	1	99
8	1.045	1.075	1.06	.94	2	4	96
7	1.10	1.125	1.10	.91	3	9	91
6	1.16	1.20	1.20	.83	4	16	84
5	1.34	1.30	1.33	.75	5	25	75
4	1.65	1.45–1.55	1.50	.66	6	36	64
3	2.17	2.00	2.00	.50	7	49	51
2	3.34	3.00	3.03	.33	8	64	36

The first column in the table gives the thickness of the bed in feet; the second the average cost of mining anthracite at these thicknesses, according to Chance (not including breakerage charges); the third column, the computed relative cost for bituminous coal; the fourth column, the approximate combination of the two; the fifth column, the relative values of beds of the same quality of coal of different thickness, obtained by dividing 100 by the cost, given in column 4; the sixth column, the difference in feet between 10 and the particular thickness given; the seventh column, the square of the numbers in column 6; the eighth column, the result of subtracting from 100 the square of the difference between 10 and the thickness in feet. By comparing columns 5 and 8, column 8 is seen to give a close approximation to the computed figures in column 5, and as the figures in column 5 are by no means absolute and fixed the figures in column 8 have been taken as fairly expressing the relative value of different thicknesses of the same coal; but this is found by subtracting from 100 per cent a percentage equal to the square of the difference between 10 and the thickness, or $\frac{100}{100}-\frac{(10-t)^2}{100}=1-\left(\frac{10-t}{10}\right)^2$. The value per ton of a bed less than 10 feet thick of a given grade of coal may therefore be found by multiplying the normal value per ton for a 10-foot bed of coal of that grade by $\left(1-\left(\frac{10-t}{10}\right)^2\right)$.

In valuing land by the acre-foot, however, an additional factor must be considered, namely, that a larger recovery of coal per acre-foot is possible from thin beds than from thick beds. This difference offsets in a measure the rapid increase in mining cost with thinning of beds. Thus 1,000 tons an acre-foot for a 10-foot bed and 1,200

tons an acre-foot for a 6-foot bed are considered fair recoveries. But 1,000 tons of coal at 1 cent a ton is $10, and 1,200 tons at 0.84 cent a ton (84 per cent being the corresponding value of a 6-foot bed) is $10.08. It is then practically immaterial whether land containing a 6-foot bed is valued at 84 per cent of the normal value of land containing a 10-foot bed of coal of a certain grade and an assumed recovery of 1,200 tons an acre-foot or whether the same value per ton and the same recovery per acre-foot are assumed as with the 10-foot bed. As the latter treatment is the simpler it has therefore

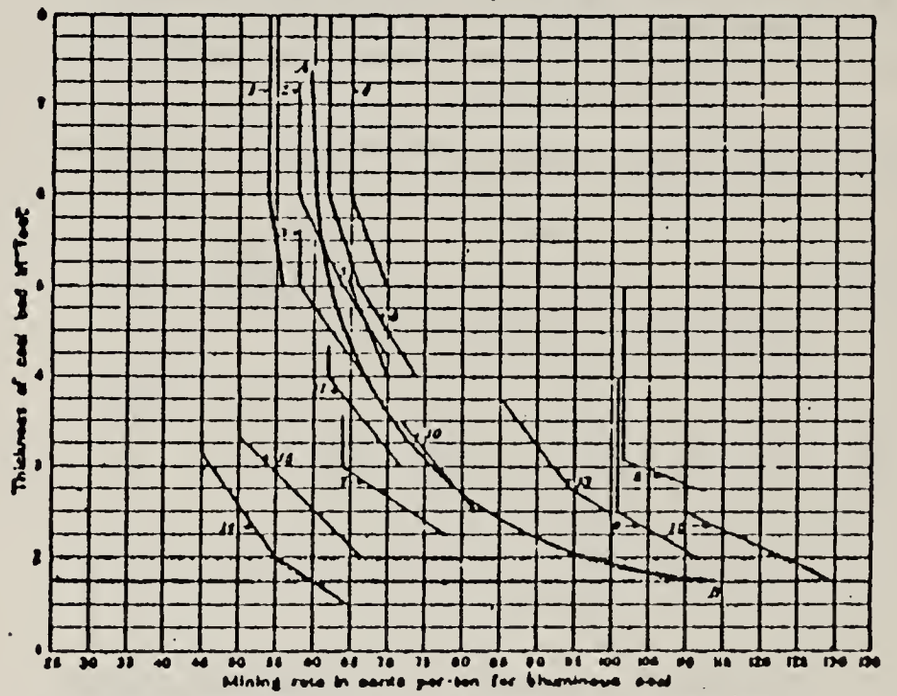


FIGURE 4.—Rates paid in the United States for mining coal of specified thicknesses and curve (*A–B*) showing average relation between mining rate and thickness. 1, 2, 3, Wyoming, southern fields, run of mine, agreements of 1912. 4, 5, Colorado, northeastern coal fields, run of mine, agreements of 1913. 6, Montana, Bed Lodge field, run of mine. 7, Indiana, miscellaneous agreements, run of mine. 8, Indiana, block coal agreements, screened. 9, Michigan, summary of agreements of 1910. 10, Missouri, summary of agreements, run of mine. 11, Missouri, Bates and Vernon counties, run of mine, agreements of 1908. 12, West Virginia, summary of agreements, screened. 13, Kentucky-Tennessee, Jellico mining district, screened. 14, Tennessee, Durham Coal & Iron Co., run of mine. 15, Tennessee, summary of agreements, run of mine.

been adopted and the value of a ton of any coal in the ground is taken as constant for thicknesses between 6 and 10 feet.

The rate of increase in cost of mining a bed less than 6 feet thick, however, is too great to be compensated for by the greater recovery per acre-foot. After making various assumptions as to fair average acre-foot recovery for thin coals—assumptions based on known recoveries—and after computing the value of the coal in thin beds, accord-

ing to the formula given on page 84, it was decided to avoid a sliding scale both in value and recovery by reducing the value of beds less than 6 feet thick 10 per cent for each foot below 6 until the minimum for that coal is reached. Thus the coal in a 5-foot bed is computed at 90 per cent of the value per ton of the coal in a 6-foot bed, the coal in a 3-foot bed at 70 per cent of the value per ton of the coal in a 6-foot bed, and so on. This reduction for the value of the coal in beds less than 6 feet thick is readily computed by multiplying the normal value per ton by $\frac{4+t}{10}$, where t is the thickness in feet. Figures showing the results obtained by multiplying the relative value of coal in thin beds, given in column 8 of the preceding table, by various assumed rates of recovery were plotted on cross-section paper and an arbitrary line was drawn through the middle of the group of lines so obtained. This line is practically a straight line, giving a reduction in value of 10 per cent for each 1-foot reduction in thickness, and was accepted as representing fair average relative values.

Sufficient data were not at hand on the relative cost of mining coals more than 10 feet thick to lead to definite figures, or figures having more than approximately authoritative value. It is, however, generally recognized that the cost of working coals does not continue to decrease indefinitely as the beds increase in thickness, for the increased cost of timbering and increases due to other practical difficulties gradually overcome the gain due to smaller acreage, and increases for the thick coals in general probably entirely offset that gain. From beds more than 10 feet thick, other things being equal, the recovery per acre-foot decreases with increase in thickness, owing to the necessity of leaving larger pillars and the difficulty of reaching all the coal. It has therefore been assumed that the recovery diminishes on each additional foot above 10. Thus a 16-foot bed takes first the normal value on 10 feet; next the eleventh foot is valued at only 99 per cent of the value fixed for the tenth foot, the twelfth foot at 98 per cent, and so on, the sixteenth foot having a value of only 94 per cent of the value fixed for the tenth foot.

In computing acre values on beds over 10 feet thick it has been found best to use the normal basing value in cents per ton of a 10-foot bed and assume the same recovery per acre-foot and then compute the thickness (t') of a bed that without deduction will yield the same acreage recovery as the bed in question. Where the thickness in feet (t) is more than 10 the equivalent thickness (t') is expressed by the following formula: $t' = 9 + \frac{t-9}{2}\left(2 - \frac{t-10}{100}\right)$.

Summarizing the above: The Government price per ton for a bed 6 to 10 feet thick will range from 6.4 mills (0.64 cent) for an 8,000 B. t. u. coal to 1.2 cents for a 15,000 B. t. u. coal, but if a coal is of coking quality its price may be increased to a maximum of 2.4 cents, or if its quality is low it may be decreased to one-tenth cent or less.

In computing the thickness of a split or broken bed for valuation the same allowance is made as in considering classification.

The following table gives the computed value per acre of ordinary coal beds of different B. t. u. and different thickness:

Normal price per acre of coal land containing one bed of coal with heat values from 10,000 to 15,000 B. t. u. and thickness from 1 foot 6 inches to 50 feet.

Actual thickness.	Equivalent computed thickness.	Price per acre.						Tons per acre at 1,750 tons per acre-foot.
		10,000 B. t. u.; 0.8 cent per ton.	11,000 B. t. u.; 0.88 cent per ton.	12,000 B. t. u.; 0.96 cent per ton.	13,000 B. t. u.; 1.04 cents per ton.	14,000 B. t. u.; 1.12 cents per ton.	15,000 B. t. u.; 1.20 cents per ton.	
Ft. in.	Ft. in.							
1 6	1 6	* 96.00	* 97.35	* 97.92	* 98.58	* 99.36	* 99.90	2,625
2	2	* 6.00	* 10.56	* 11.52	* 12.48	* 13.44	* 14.40	5,600
3	3	* 14.40	* 14.40	20.16	21.84	23.52	25.20	8,250
4	4	25.60	28.16	30.72	33.28	35.84	38.40	11,000
5	5	36.00	39.60	43.20	46.80	50.40	54.00	13,750
6	6	48.00	52.80	57.60	62.40	67.20	72.00	16,500
7	7	56.00	61.60	67.20	72.80	78.40	84.00	19,250
8	8	64.00	70.40	76.80	83.20	89.60	96.00	22,000
9	9	72.00	79.20	86.40	93.60	100.80	108.00	24,750
10	10	80.00	88.00	96.00	104.00	112.00	120.00	27,500
20	18 8	153.60	171.20	188.73	201.84	218.00	233.30	55,000
30	27 16	223.60	245.60	268.00	290.00	312.80	334.80	82,500
40	36 4	293.70	311.00	338.30	367.50	396.00	423.00	110,000
50	44 8	371.80	413.00	499.00	484.80	526.00	562.00	137,500

* Where the computed value is less than $20 the minimum prescribed by law is placed on the land—$20 if the lands lie within 15 miles of a railroad and $10 if more than 15 miles from a railroad.

VALUE OF IRREGULAR BEDS.

If the calculated thickness of any coal bed or group of beds shows a considerable variation in thickness and shows that this variation is not regular, it must be recognized that on any 40 acres concerning which no data are available the coal may be as thick or as thin as the maximum or minimum measured in adjacent areas. Because of the limited acreage that one purchaser may now legally buy and because he may not exchange his land for other land if it proves not to be underlain by as much coal as had been estimated in determining its price, an allowance should in fairness be made to him for possible local thinning.

If any regularity is shown in the changing thickness of the coal, the practice is adopted of drawing lines of equal thickness, a feature

best illustrated by giving a concrete case, such as is represented in figure 5.

On this map lines were drawn from the position of one measurement to the position of each adjacent measurement and the thickness was assumed to grade uniformly from one to each of the other points. Valuation is then based on the average thickness thus found for each forty that is being valued. If the measurements do not show any regularity in the change of thickness, the Survey has adopted a method of computing thickness that permits the thickness of the coal under any tract of land to be considered as less than the average of the measurements, in order to favor the buyer, for the reasons already stated. For while the coal is as likely to be above the average as below and, mathematically, is more likely to be just the average thickness than any other, yet a cautious buyer bargaining for coal would always want to discount the probability a little, as a matter of safety. If all the measurements on a bed indicate the same thickness, that thickness may be safely taken as the thickness of the coal under any land included by the measurements. If the measurements vary but slightly from the average, the thickness under the land where no measurements are obtained is not likely to be much below the average. If, however, the variation is large, the coal in some places may be even thinner than the smallest measurement; yet to assume that the coal under all the land where no actual measurements were made is as thin as the thinnest measurements obtained would be overcautious. A more probable thickness is obtained by multiplying the average of the measurements by $(1-\frac{8D}{8})$;

in which 8 is the sum of all the measurements and 8D is the sum of the numbers obtained by subtracting from the average each measurement below it or subtracting the average from each measurement above it. For example, if the measurements on a given bed in a certain area are 4 feet, 5 feet, 7 feet, 8 feet, 4 feet, 8 feet, 5 feet, 2 feet, 4 feet, 2 feet, 6 feet, and 10 feet, the average of all the measurements is 5 feet; the sum of the measurements is 60 feet; the difference between the several measurements and the average 5 feet is 1 foot, 0, 2 feet, 2 feet, 1 foot, 3 feet, 0, 3 feet, 1 foot, 3 feet, 1 foot, 5 feet, which added together give 21 feet; so 21 feet divided by 60 has been called the "modulus of irregularity" and has been adopted as a factor of safety; $1-\frac{21}{60}$ or 100 per cent − 35 per cent = 65 per cent; 65 per cent of 5 feet = 3¼ feet; therefore 3¼ feet is taken as a safe average thickness on which to sell the coal—in other words, the thickness which it is highly probable will be reached or exceeded by the coal under any of the land within the area of the measure-

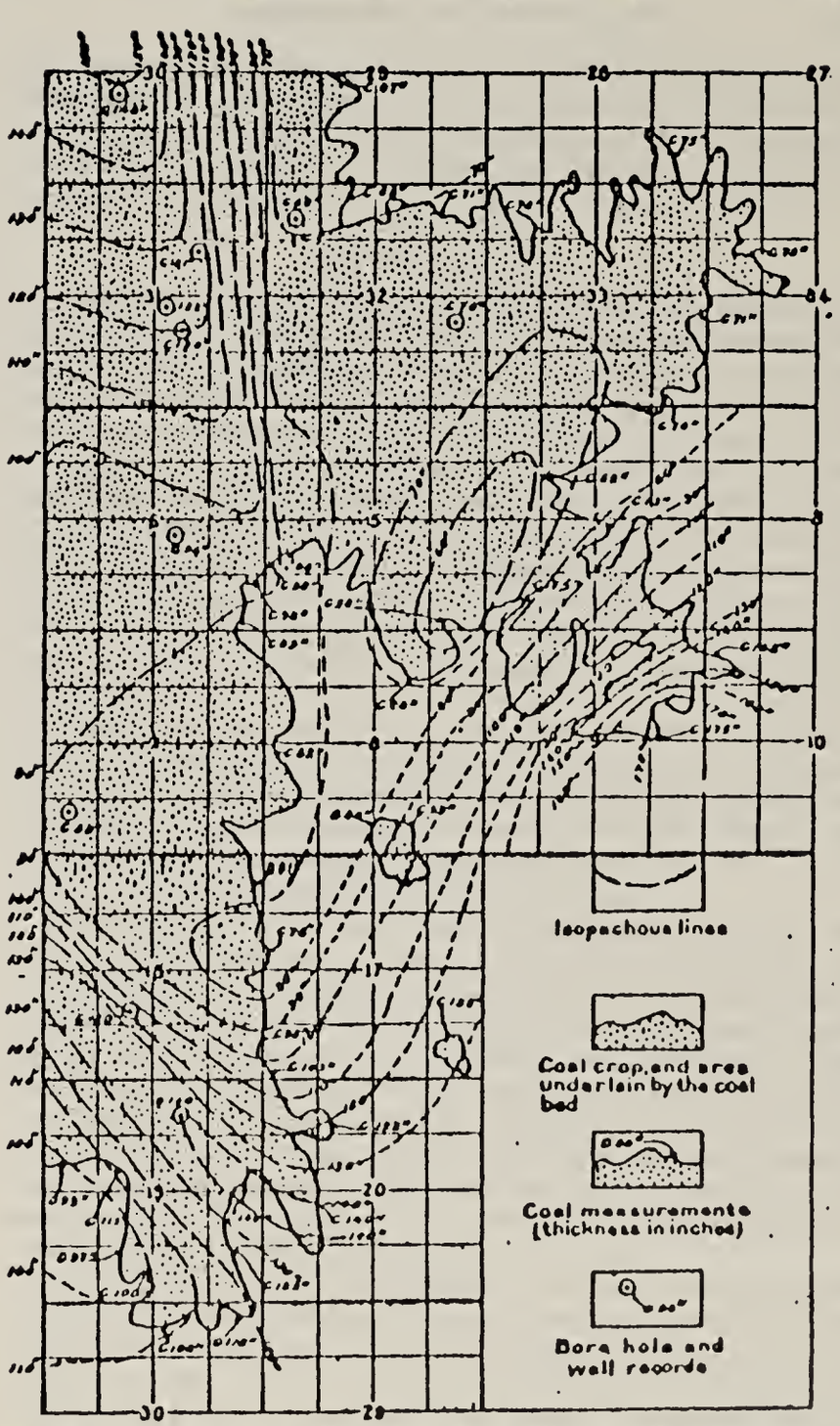


FIGURE 5.—Sketch map showing lines along which a coal bed is of equal thickness (isopachous lines), drawn for use in the valuation of coal land.

ments given. In this, of course, the Government is favoring the buyer to the extent that the computed safe average is below the actual average of measurement; but, on the other hand, it is believed that this is no more than would properly be demanded by the average purchaser of private coal lands who, knowing the measurements of thickness on the land to be purchased, wishes to safeguard himself against the possibility that the measurements will prove to be above the average of all of the coal. This safeguard is, of course, in addition to the allowance for such a possibility in the purchase price.

VALUE PER ACRE

The Government prices for coal land are based on an assumed possible recovery of 1,000 tons per acre-foot. As an acre of coal a foot thick contains 1,750 to 1,800 tons, this recovery represents about 60 per cent of the coal in the ground. This percentage was long used in commercial estimates, though at present it is usually much exceeded by the percentage actually recovered in all good coal mining, especially in the bituminous fields of western Pennsylvania and in many regions in the Central West where the longwall method of mining has been practiced, by which the recovery in many places is estimated at 90 per cent or more.

Although a recovery of 1,000 tons per acre-foot is fixed in the regulations and is used in all computations, the value per ton assumed for coals thinner than 6 feet or thicker than 10 feet recognizes the recovery of more than 1,000 tons per acre-foot for coal in thin beds and of less than 1,000 tons per acre-foot for coal in very thick beds, thus avoiding the use of a variable recovery factor in making individual computations.

If more than one bed underlies a tract of land the early rule in valuing was to take the normal value of the bed likely to be worked first, 60 per cent of the value of the bed next worked, 40 per cent of the value of the next, and 30 per cent of the value of any others, the reduction being made on the beds not worked at first to allow for interest on the investment for the long period during which they remained in the ground. Fuller consideration of this subject, however, and closer study of the operation of many mines that work several beds simultaneously or one immediately after the other and of the practical advantages of using the same plant for working beds either simultaneously or successively have led to the belief that these advantages more than outweigh the added interest that accrues during the longer period of holding.

Accordingly, under the regulations now in force, consideration is had only of the total quantity of coal in the ground, no reduction being made for interest on the investment if, after allowance for

the reduced value of the thin beds, the sum of the thicknesses of the beds does not exceed 10 feet. If the total thickness of the coal under a tract of land, after reduction for thin beds and for partings, is more than 10 feet, the total value of the coal is computed by the formula previously given for computing the value of thick beds.

REDUCTION FOR DEPTH.

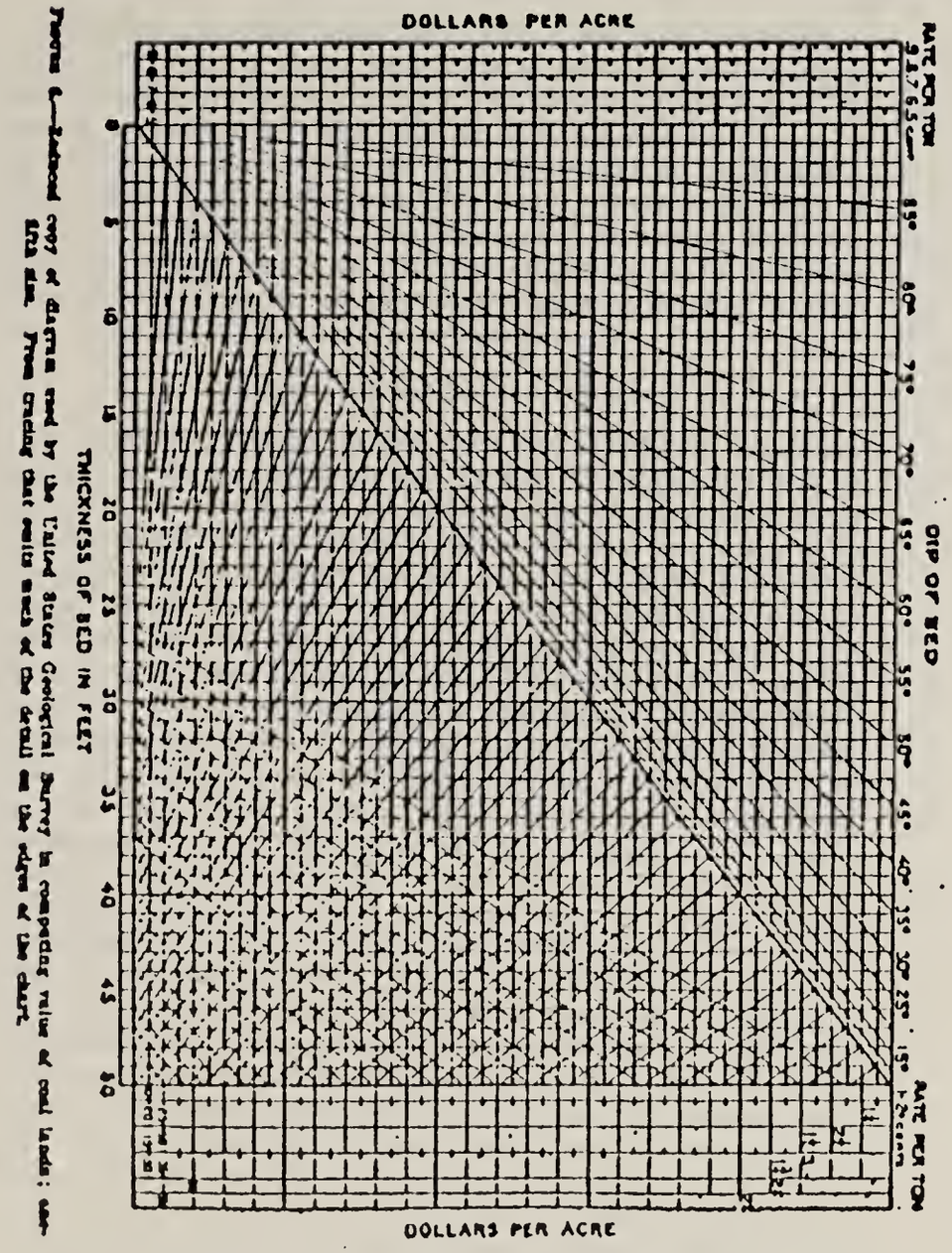
It has been pointed out that the determination of the depth to which a coal may be profitably mined is a problem involving the consideration of diminishing profits. If a coal that is being mined near the surface is yielding a net profit of 25 cents a ton and if the cost of mining it increases 1 cent a ton for every 100 feet of increase in depth (purely an assumption), it is evident that the profits will disappear when the mine has reached a depth of 2,500 feet, so that the coal becomes unminable at a reasonable profit at some point of less depth, say 2,000 feet. Obviously anything that increases the profits—such as a gain in quality—will increase the depth of profitable mining, and anything that decreases the profits—such as an increase in the cost of mining—will decrease the depth of profitable mining.

If depth limits are assumed for coals of different grades and different thicknesses, it may also be assumed that the cost of mining increases uniformly with increase of depth, though it is strongly suspected that the cost of mining increases at an accelerating rate as the depth increases, but as sufficient data to prove this are not available a uniform rate of increase has been assumed.

If a certain coal has a normal value at any depth within 500 feet of the surface its value has been assumed to reach zero at its depth limit, and its price has been decreased uniformly from a point where it goes below the 500-foot depth down to its depth limit. If, for example, a bed has a value of $60 an acre at the depth of 500 feet and its depth limit is 2,500 feet, and if it reaches its depth limit 3 miles beyond the point where it lies at a depth of 500 feet, its dip remaining constant, it loses a value of $60 in crossing twelve 40-acre tracts, or $5 for each forty. The successive forties underlain by this coal would therefore be valued at $55, $50, $45, $40, $35, $30, $25, and thence to the depth limit at $20.

Ordinarily the depth of a bed does not increase uniformly to its limit, but its steepest pitch or dip is at its outcrop and its dip gradually lessens toward the center of the basin in which it lies. Its depth at all places is indicated on the field sheets by contour lines representing uniform elevations above sea level. From these contour lines it is possible to compute the average depth of the bed under any 40-acre tract, and, the rate of diminishing value having been

established by dividing the difference between the depth limit and 500 feet by the normal value at the surface, each 40 acres can be



valued accordingly. The average depth of coal in a forty that is crossed at an angle by the outcrop or the depth-contour lines is the depth at the geometrical center of the area underlain.

If the dip of the coal bed whose value is given above had not been regular the rate of its diminishing value would have been $\frac{2500 \div 500}{60} = \$1$ for each 33⅓ feet, so that if the depth under a given forty averaged 1,600 feet, the value of the forty would be

$$\$60 - \frac{1600 - 500}{33\frac{1}{3}} = \$27.$$

If more than one bed of coal underlies a 40-acre tract and the beds are not close together each one is valued independently and the value of the forty is taken as the sum of the value of the independent beds. If several beds occur in a group a normal value is figured out for the group and this value is reduced according to the depth. In fixing the value of a group of dipping beds allowance is made for the change in the value of the group due to the lower beds passing below the 500-foot line before the higher beds and reaching the depth limit before they do.

Formulas have been worked out to facilitate the calculation of the value of beds involved in some of the more common types of computations in these cases are read directly from large diagrams. These diagrams contain so much matter that a reproduction of one of them (fig. 6) on the reduced scale necessary for publication in this bulletin does little more than give a general idea of their character, particularly as they are too involved to permit their description in a bulletin that is not intended to set forth details of classification.

ALLOWANCE FOR FAULTS.

Faults—that is, breaks in the rocks involving a movement of beds on either side of the break—occurring in a coal field depreciate the value of the coal for mining and in places may render it entirely unworkable. Small faults may be disregarded unless they are so numerous as to render the coal expensive or difficult to mine. If, however, the throw of the fault is large—that is, if the edges of the beds that are broken have been so far separated by movement at an angle to the bedding that entries can not handily be driven from the coal on one side of the fault to the coal on the other—the value of the land is clearly less than that in which there is no fault, its smaller value being due both to the extra cost of recovery and to possible crushing of the coal along the fault planes. The price of coal in such places is determined by considering the two parts of any forty traversed by the fault separately, and giving the normal price to the part having the higher value and 40 to 95 per cent of the normal price to the part having the lower value. From the total thus obtained 5 to 15 per cent may be deducted to allow for crushing along the fault plane.

EFFECT OF INTRUSIONS.

Intrusions of igneous rock may affect a coal bed favorably, as where they occur in sheets close above or below the coal and have had the effect of changing it from a bituminous or lower grade of coal to an anthracite. The physical character and B. t. u. value of such coals reflect amply the favorable results of the intrusion. More often the intruded masses of igneous rock are in the form of more or less vertical dikes that cut the bed in various directions. Obviously these dikes detract from the value of the bed by increasing the cost of mining, and an allowance is made in the final price in accordance with their character and extent.

ALLOWANCE FOR OTHER FACTORS.

In addition to the factors that have been specifically considered, many other factors are taken into account in valuing the land in any field. Of these the one for which the largest allowance is likely to be made is that of uncertainty. In some fields it has been possible to obtain measurements on the coal along its outcrop at points a quarter of a mile or less apart, and some of these measurements are supplemented by others made in drillings at points "back" from the outcrop, so that in such places it is possible to determine the "habit" of the bed with some degree of certainty. In other places, especially in coal fields covered with a blanket of glacial deposits, or in broad valleys where the coals are under an alluvial cover, or in other fields where, owing to almost continuous burning along the outcrops, it is difficult to get accurate information as to the thickness of the beds, an allowance is made for uncertainty—an allowance that may take the form of a greatly reduced estimated thickness of the bed or, as is more common, of a restriction of the assumed area of workable coal. It has been found that the coal of certain fields was originally deposited with more regularity in some belts and areas than in others, and in many places the coal was deposited with great regularity around the edge of a basin but not in its center. Allowance is made for the possible thinning of the coal in all such places if exact data are not at hand, and the tract is classed either as noncoal land or as coal land of the minimum value. Many other factors are taken into account, such as known poor roof or floor, which may seriously affect the cost of mining and the value of the coal in place. Allowance is made for the extra cost of mining beds that include partings by making deductions for partings, it being assumed that the extra cost due to the partings eats up the profits on an equal thickness of coal.

REDUCTIONS FOR DISTANCE FROM RAILROAD.

Distance from railroads very largely affects the value of coal land. In fixing the value of Government coal land, however, distance from railroads is not taken into account, their value being based on that of the coal itself, but, in accordance with the law, the price so fixed is automatically reduced one-half for all lands lying more than 15 miles from a railroad in operation. Some land that contains coal beds, though within 15 miles of a railroad, can not be reached by a railroad switch without going either around or over a high mountain, so that by either route its distance from the railroad practically exceeds the 15-mile limit. Such land is treated as if it were beyond the 15-mile limit and its price is reduced one-half, though not below the legal minimum—$20 an acre.

MAXIMUM PRICE.

In view of the uncertainty that may exist concerning many features of an undeveloped coal field, even if the evidence seems conclusive that it contains a large volume of coal, the maximum price of coal land is fixed by the regulations at $300 a nacre, except that if the field in which the land is situated contains very large mines, and if the coal is well known in the market and its adaptability to different uses has been demonstrated, the price of the land is computed from the value of the coal it contains, whether it exceeds $300 an acre or not.

REVIEW OF CLASSIFICATION.

According to the regulations the classification of any land as coal land is subject to review by the Secretary of the Interior, but the person making the application for review must present facts that show clearly and specifically that the land is not coal bearing in the sense of that term as it is defined in the regulations. The facts set forth in nearly all applications for review and reclassification of coal land simply show that no coal can be seen outcropping on or close to the land and that no coal has been found in drilling wells for water on or near the land. Before such applications are filed request should be made of the Geological Survey to state the basis of the classification, for a large percentage of the coal land has been classified as such because it is underlain by coal at depths of 500 feet or more, whereas the rocks at the surface contain no coal and may be of entirely different age from the underlying coal-bearing rocks. Data presented in a request for reclassification have determinative value only if they differ from data already in the records of the Geological Survey.

REGULATIONS FOR THE CLASSIFICATION AND VALUATION OF PUBLIC COAL LANDS.

The following regulations were approved February 20, 1913, by Secretary of the Interior Fisher:

II. CLASSIFICATION.

1. Land shall be classified as coal land if it contains coal having—

(a) A heat value of not less than 8,000 B. t. u. on an air-dried, unwashed or washed, unweathered mine sample.

(b) A thickness of or equivalent to 14 inches for coals having a heat value of 12,000 B. t. u. or more, increasing 1 inch for a decrease from 12,000 to 11,000 B. t. u., 1 inch for a decrease from 11,000 to 10,500 B. t. u., 1 inch for each decrease of 250 B. t. u. from 10,500 to 10,000, and 1 inch for each decrease of 100 B. t. u. below 10,000.

(c) A depth below the surface for a bed of coal 6 feet or more thick of not more than 100 feet for each 300 B. t. u. or major fraction thereof, and for a bed of minimum thickness for that coal a depth of not more than 500 feet, and for beds of any thickness between the minimum and 6 feet a depth directly proportional to that thickness within these limits, provided that, if the coal lies below the depth limit but within a horizontal distance from the surface not exceeding 10 times the depth limit, or if its horizontal distance from the foot of a possible shaft (not deeper than the depth limit) plus 7.5 times the depth of such shaft does not exceed 10 times the depth limit, the land shall be classified as coal land; provided, further, that the depth limit shall be computed for each individual bed, except that where two or more beds occur in such relations that they may be mined from the same opening the depth limit may be determined on the group as a unit, being fixed at the center of weight of the group, no coal that is below the depth limit thus determined to be considered.

2. Classification shall be made by quarter-quarter sections or surveyed lots, except that for good reason classification may be made by 2½-acre tracts or multiples thereof described as minor subdivisions of quarter-quarter sections or rectangular lotted tracts.

III. VALUATION.

3. For purposes of valuation the price per ton for a noncoking, nonanthracite coal 6 to 10 feet thick shall be one-tenth of a cent for each 1,250 B. t. u.:

(a) Provided that the price per ton may be increased by not more than 100 per cent if the coal is coking, smokeless, or anthracitic or has other enhancing qualities; or it may be decreased for high sulphur or ash, friability, or nonstocking or other qualities that reduce the value; and

(b) Provided, further, that if the coal in one bed is over 10 feet thick the price on each foot above 10 feet shall be reduced 1 per cent for each such foot (thus the reduction will be 1 per cent on the eleventh foot, 2 per cent on the twelfth foot, and so on); or if the coal is less than 6 feet thick the price shall be reduced by multiplying the normal value by $\frac{4+t}{10}$, where t equals thickness in feet; and

(c) Provided that where the thickness of any bed varies irregularly its computed thickness (CT) over any area shall be equal to the average of the measurements (AM) less the sum of the differences between each measurement and the average of the measurements (SD) divided by the sum of the measurements (S):

$$CT = AM - \frac{SD}{S}$$

4. The value of any acre within 15 miles of a railroad in operation shall be determined at the rate per ton prescribed above on an estimated recoverable tonnage of 1,000 tons to the acre-foot:

Provided that if the coal is in several beds having an aggregate thickness of more than 10 feet (if beds less than 6 feet thick are considered at the reduced thickness as prescribed above, the value due to each foot above 10 feet shall be reduced 1 per cent for each such foot (as in computing the price per ton on a single thick bed) up to a thickness of 80 feet, above which any additional thickness shall be valued at 80 per cent of the normal value.

5. This price shall be decreased one-half if the land is more than 15 miles from a railroad in operation, or if it is within that limit but inaccessible owing to topographic conditions; but no land shall be valued at less than the legal minimum price, nor shall the price of any land exceed $100 an acre except in districts which contain large coal mines and where the character and extent of the coal are well known.

6. Within the above restrictions a graded allowance shall be made for increasing depth, and allowance may be made for any special conditions enhancing or diminishing the value of the land for coal mining.

7. If only a part of a smallest legal subdivision is underlain by coal the price per acre shall be fixed by dividing the total estimated coal values by the number of acres in the subdivision, but this price shall not be less than the minimum provided by law.

8. When lands which were at the time of classification more than 15 miles from a railroad are brought within the 15-mile limit by the beginning of operation of a new road, all values given in the original classification shall be doubled by the register and receiver.

9. Review of classification or valuation may be had only on application therefor to the Secretary, accompanied by a clear and specific statement of conditions not existing or not known to exist at the time of examination.

RESTORATION.

After the classifications and valuations are completed the lands are restored to entry. Those that contain no coal resume the status that they had prior to the withdrawal. The coal lands, after restoration, may be acquired under the coal-land laws at the valuation prices, surface entry under the agricultural-land laws and the State selection

acts being permitted at any time prior to their alienation under the coal-land laws. A typical order of restoration is given below.

DEPARTMENT OF THE INTERIOR,
UNITED STATES GEOLOGICAL SURVEY,
Washington, February 18, 1913.

The honorable the SECRETARY OF THE INTERIOR.

SIR: The classification of the lands listed below, which are included in an existing withdrawal, has been completed and reported to the Land Office, and I therefore recommend the submission to the President, for appropriate action, of the following order of restoration, involving 264,000 acres, all noncoal. These lands are not included in petroleum or phosphate reserves or in national forests, but part are within a power-site reserve.

Very respectfully,
GEO. OTIS SMITH,
Director.

FEBRUARY 18, 1913.

Respectfully referred to the President with favorable recommendation.
WALTER L. FISHER,
Secretary.

ORDER OF RESTORATION.

Coal-land restoration—Idaho No. 10.

So much of the order of withdrawal made heretofore for the purpose of coal-land classification, namely, Idaho No. 1, as affects the lands hereinafter described is hereby revoked for the reason that the Director of the Geological Survey has classified these lands. This revocation does not affect withdrawals or reservations other than as above set forth.

Boise meridian.

T. 55 N., R. 1 E., all of township.

[Here follows the remainder of the land description.]

WM. H. TAFT,
President.

FEBRUARY 18, 1913.

FIELD WORK ON COAL LANDS.

GENERAL NATURE OF THE WORK.

The second general step in the process of classification is to obtain in the field the information there available that is necessary for the classification. Field work that is done expressly for the classification of coal land involves all research that is made in general geologic field work but gives special weight to certain factors. The information needed for classifying coal land relates to (1) location, (2) stratigraphy, (3) horizontal extent and thickness of coal beds, (4) vertical position, and (5) quality of the coal. These may be taken up in turn.

LOCATION.

In work done for classification all the points or features concerning which information is obtained in the field must be accurately located with reference to the land lines, for if locations are not exactly specified the information is of little value. For example, a geologist may study an outcrop of a 30-foot bed of coal, measure its sections, photograph it, and sample and analyze the coal to determine its quality or test it in any other way, but if, when he has done all these things, he can not tell whether the outcrop is in sec. 31 or sec. 32 of a given township, the information he has gathered is entirely valueless for purposes of classification. It is therefore necessary that all the features to which his information relates be accurately located on his field maps, with special reference to township and range lines, section lines, and quarter-section lines, and even accurately within the 40-acre tracts, as it is desirable to know exactly how many acres of the forty are underlain by coal in order to determine the value of that particular forty. The methods of survey by which the geology is tied as accurately as possible to the public-land net have been described in a preceding chapter.

STRATIGRAPHY.

The first purpose of gaining a thorough knowledge of the stratigraphy is to be able to recognize groups of rocks that are coal bearing elsewhere or to recognize other rocks that the wide experience and knowledge now available concerning the geology of the Western States have shown not to be coal bearing. The second purpose is to determine, from such data as may be obtained on the surface, the "lay" or structure of the coal-bearing formation and the groups of coal beds it contains.

Just as in the Eastern States it has been found that workable coal beds are confined to a particular part of one large group of rocks, which has long been designated the "coal measures," so in the West it has been found that workable coal beds are confined to relatively few groups of rocks, which are separated usually by great thicknesses of other rocks that are nowhere known to contain workable coal beds. As the sedimentary rocks of the West consist mainly of sandstones, shales, and limestones, those of like lithologic character being similar to one another in general appearance, the particular sandstones and shales with which the coal beds are associated can as a rule be distinguished only by means of the fossil plants or animals that are associated with them. Thus it has been found necessary to employ the services of several experienced paleontologists to examine the fossils associated with the rocks and from these fossils to determine the age of coal-bearing formations.

The first step of the geologist who has been sent into a field or area that is known or has been reported to contain workable coals is usually to determine what groups of rocks occur in that region and then, knowing the groups of rocks that contain workable coal beds in other places, to concentrate his attention on those groups, hunting for coals in them. Having found the coals his next work is to determine the number of groups of coals, as the same territory may contain two or three or even more coal-bearing formations, though usually they occur in different parts of the same field. His next step is to examine the several coal-bearing formations in order to determine, if possible, the number of coal beds in each. This work naturally leads to the determination of the areal extent and thickness of the beds.

EXTENT AND THICKNESS OF COAL BEDS.

Coal is a rock that has been formed from vegetal matter. The vegetation may have grown where the coal bed is now found, much as it grows in the great peat bogs of Europe or some of the large swamp areas of this country, or it may have been washed or drifted from the place where it grew to the place where it now occurs as coal. In changing from a mass of decaying vegetal matter to a bed of coal its volume has decreased and its weight per cubic foot has greatly increased. It has also lost many of the elements of the plants, especially the moisture they contained, and if during its formation the coal bed was inundated by muddy waters its vegetal matter may have been overlain or intermingled with sand or mud. This material may have been added in small quantities at frequent intervals, simply rendering the coal "dirty," or it may have come in at long intervals and then in large quantity so as to form a blanket of mud or sand, which, being covered by renewed accumulations of vegetal matter, becomes a parting of clay or sandstone in the coal bed. In a few places a single coal bed has been deposited in a formation, and thousands of feet of other rocks have been laid down beneath and above it, no other coals having been formed. More frequently, however, where coal-forming conditions have existed they seem to have recurred in such a way that a succession or series of coal beds are laid down in the same area. In one region most of the coals in a group deposited in that way may be thicker in the same general area, and all the beds may tend to thin away from that area. In another region one bed of a group may be thicker in one locality and a higher bed of the same group may be thicker in another locality.

Coal beds vary greatly in extent, ranging from pothole fillings having about the shape though not the size of a kettle to flat-lying beds thousands of square miles in extent. In Missouri a number of coal beds have a thickness in places of 00 feet or more and

an areal extent of only a few hundred feet or less, being simply fillings of deep holes in the rock, similar in shape to the "pot-holes" that are so abundant around some waterfalls. In other places, as in the Sharon field of Ohio, the coal bed has the shape of a valley, with branches where side streams have come in, and a single mine may follow one of these valleys for some distance, the coal being confined to a width of perhaps a few hundred yards but extending indefinitely up and down the valley, which in some places winds tortuously. In still other places, as in the Block coal field of Indiana, the coal occurs in a succession of shallow basins, the beds having a thickness of 3 to 5 feet in each basin and thinning out to a few inches between the basins. The bottoms of the basins lie 20 to 30 feet below their rims. Some of these basins are so small and so close together that the coal from several of them is extracted by a single mine, the entries being cut through the rock from the lower level of one basin to the lower level of the next basin. Other basins have a length of 2 or 3 miles in a northwest-southeast direction and a width of one-half mile or more. Some of the individual beds can be traced from basin to basin and clearly recognized by peculiarities in the coal. In other fields the coal appears to have been deposited unevenly in little depressions that are scattered irregularly over a large territory and lie at various levels, so that it is not possible to trace a bed from one point to another, and each little basin must be considered as a unit. From these types of irregular and narrowly limited coal beds every gradation may be found to some of the relatively even and continuous beds of the West, the extensive beds of the central interior coal fields, or the Pittsburgh and other beds of the East, which have an outcrop line hundreds or even thousands of miles in extent and were laid down in a more or less continuous sheet, many of them covering thousands of square miles. Thus the Pittsburgh bed has a known extent of over 6,000 square miles and is found in isolated areas beyond the limits of the main bed. Other Appalachian coal beds are of much greater extent, some of them, as the Lower Kittanning, having many times the areal extent of the Pittsburgh bed, though not its regularity.

Certain coal beds in the Illinois fields have been traced without question as to their identification over a large part of that State, through a portion of western Kentucky, and through the entire length of the Indiana coal field. It is believed that many of the coal beds of the Western States are also traceable over large areas. Most of these widely extended coal beds have certain slight but definite features or peculiarities or are associated with other rocks of distinctive character, so that it is possible to recognize them at any point. The peculiarity of a bed may consist of some particular type of parting or arrangement of partings which may hold for long dis-

tances, or it may consist of the presence just above or below the bed of a stratum that has easily recognizable characteristics. In order to trace and identify some coal beds it is necessary to study their relations to one another. One of the main reasons for studying the stratigraphy is to identify if possible at the outset the group of coals studied, and in this work note should be taken of the determinations reached by the wide study of the same formations in previous seasons. For example, in the great coal field that covers much of western North Dakota and part of South Dakota, all of southeastern Montana and the great Powder River field of Wyoming, there are two coal-bearing formations—the Fort Union above, named from its early recognition at Fort Union in North Dakota, and the Lance formation below, named from the occurrence of those rocks on Lance Creek in Wyoming. The Fort Union coals are as a rule persistent; they have local thicknesses of 10 to 80 feet or more, and some of them can be traced for hundreds of miles along their outcrop, and individual beds can be recognized from point to point. On the other hand, the Lance coals occur as a rule in small lenses, most of them a fraction of a mile or a very few miles in extent. The coal in these lenses ordinarily is but little above the minimum workable limit and thins rapidly to nonworkable thickness in all directions. If the geologist knows that the coals in any particular area are in the Fort Union or Lance formation he knows what to expect concerning them, for if he finds that they are of Lance age and he is studying at the moment the coal at a point where it is workable, he is careful to trace it if possible in order to see how far it may extend before it becomes unworkable, so as to determine as closely as practicable the extent of that particular lens. If, on the other hand, he knows that the coal before him is of Fort Union age he attempts to determine, if possible, what particular coal bed in the Fort Union it is, and, assuming that he will find that same bed in a large part of the country ahead of him and that he will judge of its thickness by combining a great number of measurements made over a large territory, he does not with the same attention attempt to discover whether the coal pinches out a short distance on either side of the point where he is standing. In all of this work it is, of course, not safe to assume too much, for toward the south end of the Powder River field the beds of coal in the Lance formation increase in extent and thickness, so that they more nearly resemble those of the Fort Union formation, farther north.

It is not advisable to assume absolutely that, because in some area already examined a coal bed is very extensive and keeps the same thickness with great regularity, it will continue to be extensive and regular in territory that may be studied later. For example, the Pittsburgh bed, which maintains a very uniform thickness over a large area in western Pennsylvania, becomes very irregular in southern Ohio, so much so that it has been wrongly identified, and it is only within a few years that the bed there identified as the Pittsburgh has been shown to be another coal higher in the series. Likewise, in the Illinois-Indiana field coal V, which is probably the most persistent bed in that field and can be traced along its outcrop for thousands of miles with great regularity, pinches out in parts of Greene County, Ind., close to other localities where it shows its greatest thickness; and, again, in Warrick County it loses its usual characteristic roof and is split into two distinct beds. In the same way many of the coals in the West that on casual scrutiny appear to be persistent prove, when studied in detail, especially in connection with mining operations or where close prospecting has been done with a drill, to vary considerably both in thickness and in distance apart. For example, at Castlegate, Utah, four beds are at one point separated by 50 feet, 20 feet, and 14 feet of strata, whereas a short distance away these intervening rocks pinch out and the four beds, which separately are on the average only about 3 feet thick, come together to make a single bed 12 feet thick. Drilling in that field has shown that all the beds tend to be very irregular, splitting and combining again and changing in thickness, so that in tracing them from drilling to drilling it may be found that though each core shows certain workable beds, yet a bed that is thick at one point is thin at the next. Detailed work in many of the eastern fields where extensive mining operations have afforded minute data in regard to the coal, or where thousands of dollars have been expended in drilling, has shown that even the most persistent of the beds are subject to variations, so that a bed which can be traced from one mine to another over a whole county and which may show a variation of only a few inches from mine to mine may suddenly, in mining parlance, "go to pieces." It is therefore the special work of the field geologist not only to locate the coal on the ground but to make as detailed a study as possible of its thickness and extent in order to learn just how far it maintains a workable thickness, how persistently it maintains a given thickness, and whether it is likely to vary greatly from point to point and also to determine, so far as he can, any or all of its features. Space does not permit the detailed description here of all the possible irregularities that may occur in a coal bed, for which the field geologist must be on the lookout.

In some fields the coal beds are exposed in cliffs or steep slopes in such a way that the coal may be seen almost continuously for many miles. In such places the geologist takes the opportunity to make a careful study of the regularity or irregularity of the coal beds with reference both to their thickness and to the variability or regularity

in thickness and in character of the intervening rocks and of the spaces between the beds. In regions in which the beds are not well exposed it may be possible, from a knowledge of the position of a bed with reference to other rocks which show on the surface, to determine exactly the position of the particular coal under consideration and, by means of a very small amount of digging, to expose the bed so that its thickness and partings can be measured. In some coal fields hundreds of such openings have been made in the study of the bed. In other fields the beds occur in rocks that weather down to soils rapidly, and it may be only where a coal bed crosses a stream or is otherwise exposed that it can be located or seen. It may be difficult to trace such a bed from point to point, and in some places where exposures are several miles apart it may be difficult or impossible to determine exactly its position. In other places beds may be traced readily, but the fact that they have been burned continuously along their outcrops makes it difficult to get accurate information concerning their character and thickness. It is of course possible to map the position of the coal bed in such places and it is then necessary, from such information as can be obtained concerning the thickness and character of the coal, to infer its character at points between these places. It is especially in such areas that a general knowledge of the "habits" of the bed or group of beds assists in their classification, for if it is known that a particular bed, whose burned outcrop has been traced with detailed measurements perhaps at only one or two places in a township, occurs at a certain horizon in a certain formation, it is possible to surmise whether it is regular or irregular in the broad area between these exposures, where no information on the bed itself can be obtained. Again, it may be possible, by making a careful study of a coal in a mining region, to apply the information to a wide area where but scanty information on the coal itself can be obtained. Wherever the coal is exposed the field man makes careful examination and measurement of every possible section, measuring down to the fraction of an inch, even though, where the bed is irregular, it is recognized that another measurement made a short distance away may be quite different. Where a bed is irregular special effort is made to obtain as many measurements as possible, in order to obtain average figures for use in the classification and valuation of the land underlain by that bed. In some places where the data are very meager, as in regions where the rocks crumble to soil and the land is largely meadow land, considerable time has been given to making openings on the coal because of the necessity of having actual information and measurements as a basis for classification.

ATTITUDE AND DEPTH OF THE COAL.

As already stated, the coal throughout wide areas lies entirely below the level of drainage—in places hundreds or even thousands of feet below—and the outcrops of the particular coal beds on which land is classified as coal land may be scores of miles away. It therefore becomes necessary for the field man to determine as accurately as possible not only the position of the coal outcrop with reference to the land lines and the thickness of the coal as exposed along the outcrop or the extent of the lenses, but also the depth of the bed beneath the surface and its attitude as it dips into the basin. He does this, first, by studying the inclination of the coal beds where they dip into the ground and, next, by studying the inclination and thickness of the other rocks that overlie them. As coal beds lie more or less nearly parallel with layers of sandstone, shale, and limestone, one of his duties is to determine how nearly the coal beds are parallel with these other rock layers. If he finds by observation at many points that there is very little variation in the interval, say 800 feet, between a limestone bed above and the coal bed that he is studying, he may assume that the dip of that limestone bed measured possibly at a point a mile back from the outcrop of the coal indicates the dip of the coal beneath that point at a level 800 feet below the surface. If, again, he finds that some other rock bed a thousand feet above the coal bed is parallel to it, he may assume that a measurement of the dip of that bed taken 5 or 10 miles back from the coal outcrop may indicate rather closely the dip of the coal bed itself 1,000 feet below. Hence the field geologist must not only study the details of the coal bed along its outcrop, but must also study the geology of the area back of that outcrop, especially with reference to the dip of the rocks. If, as sometimes happens, he finds that the space between a coal bed and the overlying rocks is variable, he can not compute the depth of the coal bed so closely. In some places all the rocks associated with certain coal beds, having the same great folds and basins, have been overspread by a blanket of other rocks that do not have the same structure. Such a blanket may completely hide not only the coal-bearing formation but the other formations that are associated with it and that have been folded in the same way. In such places it is only possible to infer from broad general knowledge of the field how deep the coals may lie below the surface.

QUALITY OF THE COAL.

The character and quality of a coal can be determined in part by a simple examination of the coal bed. Thus it is possible in most examinations to determine whether a coal is a lignite, a subbitumi-

nous coal, a bituminous, a cannel, or an anthracite coal. It may also be possible to estimate rather closely whether or not a coal contains a large amount of ash. Where small mines or prospects have been opened it may be possible, by studying the coal on the dump, to determine whether the coal can be shipped or stocked, or the extent to which it tends to crumble under the action of the atmosphere.

The final tests, however, are the chemical test, consisting of an analysis of the coal, which shows fully its percentage of the various heat-giving elements and of the ash and other elements that do not yield heat but detract from its value, and the test of its heat-giving value in the calorimeter. Experience has shown that coal of certain kinds—especially low-grade coal—changes in chemical composition very rapidly when exposed to the weather, so that in getting samples for analysis it has been found necessary, in order that the samples may be fairly compared and may form the basis of a uniform system of classification and valuation, that they be taken with great care in a uniform manner and that the treatment of each sample from the time it is taken until it is analyzed shall follow certain standards. To this end certain regulations have been prepared in regard to the method of obtaining coal samples for analysis and are consistently enforced. These regulations in brief are as follows:

1. Select a fresh face of unweathered coal at the point where the sample is to be obtained and clean it of all powder stains and other impurities.

2. Spread a piece of oilcloth or rubber cloth on the floor so as to catch the particles of coal as they are cut and to keep out impurities and excessive moisture where the floor is wet. Such a cloth should be about 1½ by 2 yards in size and should be so spread as to catch all the material composing the sample.

3. Cut a channel perpendicularly across the face of the coal bed from roof to floor, with the exceptions noted in paragraph 4, of such size as to yield at least 8 pounds of coal per foot of thickness of coal bed; that is, 8 pounds for a bed 1 foot thick, 12 pounds for a bed 2 feet thick, 24 pounds for a bed 4 feet thick, etc.

4. All material encountered in such a cut should be included in the sample, except partings or binders more than three-eighths inch in thickness and lenses or concretions of "sulphur" or other impurities greater than 2 inches in maximum diameter and one-half inch in thickness.

5. If the sample is wet, it should be taken out of the mine and dried until all sensible moisture has been driven off.

6. If the coal is not visibly moist, it should be pulverized and quartered down inside the mine to avoid changes in moisture, which take place rapidly when fine coal is exposed to different atmospheric conditions. The coal should be pulverized until it will pass through a sieve with one-half inch mesh, and then, after thorough mixing, it should be divided into quarters and opposite quarters rejected. The operation of mixing and quartering should be repeated until a sample of the desired size is obtained. When the work has been properly done a quart sample is sufficient to send for chemical analysis. This sample should be sealed in either a glass jar or a screw-top can with adhesive tape over the joint and sent to the chemical laboratory for analysis.

Since the value of the land varies with the quality of the coal as determined by the chemist, his methods are briefly described here.[1] Immediately after the sample is received at the laboratory it is weighed and placed in a shallow tin pan in a large drying oven, in which a temperature of 30° to 35° C. is maintained. The sample remains exposed to currents of warm air in the oven until the loss between two successive weighings made six to eight hours apart does not vary more than 0.2 per cent. The loss of weight in the oven is called air-drying loss.

After being air dried the sample is crushed to a fine powder and thoroughly mixed. To determine the amount of moisture remaining in the coal after air drying, a 1-gram sample is heated for an hour at 105° C. and then cooled in a desiccator over sulphuric acid. The moisture in the sample is thus driven off, hence the percentage of loss represents the percentage of moisture in the coal. The remaining part of the sample is next used to determine the amount of ash in the coal. This determination is made by slowly heating the sample in a muffle furnace until all of the combustible matter is burned off. The remainder is ash. The volatile matter is determined from a fresh 1-gram sample in a 30-gram platinum crucible, with a close-fitting cover, heated for seven minutes over a Bunsen flame 20 centimeters high. The loss in weight minus the moisture at 105° C. is the weight of the volatile combustible matter. The sulphur is determined on a separate example by what is known as the Eschka method. The percentage of fixed carbon given in the analysis is the difference between 100 per cent and the sum of moisture, volatile combustible matter, and ash.

The calorific value of a coal, or the amount of heat that can be obtained from it, is the most important factor in classification and valuation.

The calorific value of coal is determined with a bomb calorimeter. The following is a brief description of the details of operation:

A 1-gram sample of coal (60-mesh) in a platinum tray is placed in the bomb and the lid is screwed down tightly against a lead gasket. Oxygen is forced into the bomb until the pressure is 18 to 20 atmospheres. The bomb, filled with oxygen, is placed in a brass bucket containing distilled water, the bucket having been previously placed in an insulated jacket.

The coal is ignited by electric current and is burned at once. The heat of combustion is transmitted through the walls of the bomb and is manifested in a rise in the temperature of the water. This rise in temperature is measured by a very delicate thermometer. The

[1] The methods of analysing coal and coke are fully described in Technical Paper No. 8, Bureau of Mines, by Frederick M. Stanton and Arno C. Fieldner. The method outlined here is summarized from that paper.

quantity of heat given off by the burning of the coal is determined by multiplying the product of the weights of the metal and water in the apparatus and their respective specific heats by the rise in temperature. The result thus obtained is calculated into terms of calories and British thermal units.

PREPARATION OF MATERIAL.

The preparation of material by the field man, so that it may be considered to the best advantage in the work of classification and valuation, has already been considered in the chapter entitled "Preparation of data for classification," immediately preceding the discussion of the classification of coal lands.

PROCEDURE IN CLASSIFICATION AND VALUATION.

In the actual work of classification of coal lands each area under consideration must be treated individually, yet in general a definite line of procedure is followed.

The first step is to assemble all the available data, including not only the maps and reports of the geologists who may have made a special examination of the field, but the reports of any special agents of the Land Office who have been in that field, as well as all reports of geologists who may have visited the field at some earlier time (probably for some other purpose) and all other available information concerning the land or the coal it may contain. The land-classification board has a system of graphic records which show at once the existence of any reports on the field and give references to them, so that when the case is taken up all the data available are at hand. As a matter of fact the field man will usually have familiarized himself with all these earlier data and will be prepared to present them as may be necessary.

The second step is to scrutinize carefully all these data, and by their aid to take the action or to obtain the information listed under the following heads:

1. The number, names, character, and other features of the coal-bearing formations are determined. As most of these formations extend over large areas, some of them crossing several States, a general knowledge of the formations at once suggests the probable conditions to be found in the field studied, and that general knowledge may strongly affect the action to be taken in classification and valuation.

2. The number of coal horizons or groups of horizons is ascertained.

3. The thickness of each coal bed over the field is determined, if it can be traced. If each bed can not be traced the group of coals

is studied as a whole to determine from point to point the number of beds and their aggregate thickness and value.

4. The basing value per ton of the coal is computed by comparing its analyses and its obvious character with the standard scale. An average B. t. u. value having been fixed for the coals of the field or for the different groups of coals, the other qualities of the coal—such as its adaptability to coking or to stocking—are studied to determine whether they enhance that value or detract from it, and the price is raised or lowered accordingly.

5. If the field is small and the data are scattered the field may be studied as a unit. If the data are abundant in any township the coals in that township are studied by themselves, and, exceptionally, the variation in thickness may make it necessary to divide a township into belts or areas, in each of which a basing value of the groups is determined.

6. All sections of the coal are examined, and if the coal beds are split the equivalent thickness of a solid bed is computed and a memorandum of the results is placed beside the drawn section. Then further reduction is made for the reduced value of the bed, if it is less than 6 or more than 10 feet thick. If a bed is variable in thickness but varies so regularly that lines of equal thickness can be drawn on a map of the field these lines are so redrawn as to indicate the reduced thickness determined by allowance for their reduced value if the thickness is less than 6 or more than 10 feet. If the beds are of irregular thickness the average of the measurements taken is obtained, and by the use of the "modulus of irregularity" a computed average thickness is obtained for use in valuation.

7. The outcrops of the coals are examined to determine which are workable coals and especially to make note of the outcrop of the lowest bed or the bed covering the largest area. Where the coal lies in one or more lenses a computation of its gradation in thickness is made between points at one of which the coal is below the minimum thickness and at the other is above, to determine the position of the minimum. The limits of workable coal having been determined for certain points, the limits of the lenses of the coal are drawn on the maps. For isolated measurements at points where the bed is above the minimum limit the extent and character of the several lenses measured are determined, special formulas being applied where possible.

8. If the coal passes below the depth limit of workable coal the position of that limit is determined and indicated on the map.

9. The limit of workable coal having now been determined, a line is drawn on a plat along the 40-acre lines, or, where necessary, along the 10, 5, or 2½ acre lines in the forty, to separate the area that con-

tains workable coal from the area that does not contain workable coal. The latter area is then plainly marked "noncoal," and if the land is only to be classified and not valued a copy of the plat is made on a blank township sheet to show accurately the coal land and the noncoal land. This copy, after checking and proper designation, is dated and signed by the members of the coal section of the board. Its later history is the same as if valuation had been made.

10. The tract or township may now be valued. The particular steps at this point may vary greatly, depending on the complications involved in the valuation. It may be that the coals are of a grade so low that, like the low-grade lignites, regardless of their thickness, they will be valued only at the minimum. Or it may be that the tract contains only one thin bed that lies flat and at slight depth, so that the land may be valued at the minimum or perhaps at a uniform price. From these simple conditions there will be conditions grading in complexity all the way to those found in such fields as, for example, the Rock Springs field of Wyoming, where there are three groups of beds of coal of different age, character, and quality, each group containing from six to eighteen coal beds, and where each coal bed has been accurately traced by means of hundreds of measurements made on the coal in each township, both along the outcrop and in mines and drillings. Owing to differences in quality and thickness coals have different depth limits. They may also vary in dip and may be locally broken by faulting or by igneous intrusions. The value of the land that is involved in these complications is computed by using printed blanks that contain columns arranged to show not only the observed data on each bed in each 40-acre tract, but also the computed values of each bed, ending with the computed value of the 40 acres. This completed blank becomes part of the permanent record, so that, if additional data are obtained or if for any reason the valuation should be reviewed, it shows not only the field data but the steps that have led to the final result. As values are determined they are recorded on a blank township sheet and if the data are abundant and complicated the coal boundaries may be drawn on transparent overshoots, on which the computed valuation prices are placed. This sheet is properly labeled, dated, and signed by the members of the coal section.

11. As the land in a township is classified and valued memoranda are prepared to show the basis for any criteria used, and all these memoranda, with blank forms showing the computations and allowances, are retained as "minutes" and, when reviewed and signed by the members of the coal section, form a part of the permanent record.

PROGRESS IN CLASSIFICATION AND VALUATION.

The following statement shows the status of the work of classification on January 1, 1913:

Progress of coal-land classification to January 1, 1913.

Total withdrawals	acres	128,147,812
Area classified and valued as coal land	do	16,433,817
Area classified as coal land, price not fixed	do	841,706
Area classified as noncoal land	do	42,244,082
Restored without classification	do	2,717,395
Total restorations	do	62,237,000
Total withdrawals less total restorations (total outstanding withdrawals)	acres	65,909,712
Value of coal land at classified price		$702,167,208
Value at minimum price		$279,122,601

OIL AND GAS LANDS.

OCCURRENCE OF OIL AND GAS.

To the minds of many people who find little difficulty in comprehending a classification of lands containing deposits of coal or phosphate the possibility of applying a similar classification to lands containing oil and gas, especially in advance of actual drilling, appears uncertain, to say the least, and, according to the nature and experience of the individual critic, such a classification is looked upon either as a more or less scientific guess or as evidence of the possession of supernatural powers by the classifier. The classification of oil and gas lands, however, calls for the use of no mysterious or haphazard methods but is based on detailed field examinations, followed by careful consideration of all the available facts, geologic and economic, in their relation to one another and to the known principles of the occurrence of oil, which have been proved again and again in the development of oil fields throughout the world. Although the ultimate test of the presence of oil in commercial quantities is made with the drill, it is nevertheless a fact that the intelligent application of the principles of oil accumulation to the geologic facts observed will indicate at least the areas where no oil will be found and will go far toward delimiting the areas where production is reasonably certain. To the classifier of oil lands, as to the oil-well driller, the theories proposed to account for the origin of oil and gas are of only incidental interest; the problem of prime importance to him comprises the assignment of proper values to the many factors which influence accumulation and the determination therefrom of the present position and extent of the deposits.

Oil and gas are composed for the most part of carbon and hydrogen, but they vary greatly in the proportions of these elements and in the way in which they are combined. The petroleum oils range from low-grade heavy oils containing much asphalt to high-grade light oils which contain a large percentage of paraffin and volatile constituents and little or no asphalt. The heaviest oil is chiefly valuable as fuel, for which it is used in its crude state. Progressively lighter oils are used less and less for fuel and more and more for the other products that are obtained from them. There is a general opinion that weight for weight the fuel value of light and heavy oils is about equal, but because of the value of the distillates from the lighter oils it may be stated in general that the lighter the oil the greater its value.

In classifying lands as to their probable content of oil and gas it must be borne in mind that oil and gas are mobile substances and that, owing to their mobility and to the resulting increased importance of gravitation, temperature, hydrostatic pressure, and capillarity, it is necessary to make certain variations from the type of procedure employed in classifying lands containing coal, phosphate, or other stable minerals. The mobility of oil and gas has, in many regions, permitted their migration through varying thicknesses of pervious strata to their present places of accumulation, so that the problem is not to discover where the hydrocarbons originated but rather where they have accumulated.

The present position of these accumulations depends mainly on the character of the strata, the attitude of the strata (commonly spoken of as the rock structure), the presence or absence of water, and the character and specific gravity of the oil. The fluid hydrocarbons do not, as is supposed by some, occupy underground lakes or reservoirs surrounded by walls of rock. Instead they saturate porous rocks in places where the geologic structure, the conditions with regard to underground water, and the succession of strata are such that the accumulations are sealed by relatively impervious beds. Thus, although the accumulations of oil or gas are called "pools," they are not to be confused with such pools as are formed by the collection of liquids upon the surface of the ground. The porous stratum in which the hydrocarbon collects is often spoken of as an oil or gas "sand," although it may in reality be sandstone, gravel, limestone, or a zone of fractured rock. Into this "sand" the hydrocarbon comes from one or another source, but if there is to be an accumulation of importance the migration of the oil or gas along this pervious bed must be stopped by a change in dip or by some other obstacle to continued progress, and, in addition, the reservoir thus formed must be sealed by strata that are relatively impervious,

such as compact shales, clays, or fine-grained sandy beds saturated with water.

The accumulations within the United States may be divided roughly into three classes, as indicated below.

1. Those occurring in strata of sandstone or limestone bounded above and below by rocks comparatively impervious to oil. The sandstone or limestone may be of broad or of very narrow extent, in some places comprising merely small lenses of porous material embedded in relatively impervious rocks, in others underlying hundreds of square miles of territory in comparatively regular beds. To this class belong the greater number of oil accumulations of this country.

2. Those occurring in porous strata, apparently lenticular, associated with the "salt domes" of the Gulf Coastal Plain.

3. Those occurring in fissures in shale, as in the Florence field of Colorado. The fracturing of other rocks, such as limestone and sandstone, affords favorable conditions for the accumulation of oil; but sandstone and, under certain conditions, limestone are capable of storing oil without fracturing, the fracturing merely increasing their capacity. A fine-grained shale, on the contrary, although capable of containing oil, does not permit its migration through the rock mass with sufficient rapidity for collection in wells unless the shale is broken by fissures, which serve as channels or reservoirs for the slowly migrating oil.

It may be stated as a fundamental principle that important accumulations of petroleum and natural gas are to be found only in stratified or sedimentary rocks. Regions in which the strata have been greatly disturbed or altered by intrusions of igneous rock are, as a rule, unfavorable to the accumulation of petroleum, because the attendant heat and fracturing would as a rule have had disastrous effects on volatile substances of this character. An interesting apparent exception has been noted in Ventura County, Cal., where oil to the extent of 5 or 6 barrels a day has been obtained from wells drilled in close-textured crystalline schist. Although the schist is underlain by granite, it is overlain at a distance of only a few hundred feet from the wells by Tertiary rocks which in the same general region are petroleum bearing. These relations suggest that the presence of the oil in the schist is due to infiltration from the Tertiary sediments through fractured zones rather than to origin in the sediments that were metamorphosed to form the schist.

In general, then, oil is found in sedimentary strata of greater or less extent and regularity. These strata were originally deposited by water in the ocean, in fresh-water lakes, or on great deltas practically at sea level. The beds were therefore horizontal, or nearly

horizontal, as first laid down, and where a series of beds was deposited one above another, there being no earth movement during the deposition, the several beds were parallel. After the beds of sand, mud, and marl were deposited and hardened into the resulting sandstone, shale, and limestone, they were in certain areas bent by earth movements into folds of various shapes, and it is about these folds that the accumulations of oil are found. The attitude in which the rocks lie, the shape of the folds, and the presence of faults or breaks in the strata constitute the rock structure.

In any consideration of the factors which control the accumulation of oil or gas the importance of the part played by the structure can hardly be overestimated. The fluid contents of porous beds obey the laws of gravitation and capillarity, separating and distributing themselves in the main in accordance with their specific gravities. If water, petroleum, and gas are, as is usual, present in petroliferous beds, the gas would as much as possible disengage itself from the fluid and rise to the highest point in the fold, while the water would endeavor to displace the petroleum and find a resting place as low down as possible. If the bed of rock is inclined and the water is under artesian pressure, it will be forced upward along the bed, the oil remaining above the water because of the difference in specific gravity. If the porous bed is continuous in dip to the outcrop, the gas and oil are likely to exhaust themselves at the outcrop in the form of seeps. If, however, the progress of the hydrocarbons up the dip is stopped by a fold in the bed, or by a fault which seals instead of opening the stratum, or by saturation of the bed with water, an accumulation takes place, the oil and gas remaining between the water down the dip and whatever has impeded their progress up the dip. This theory, which is known as the anticlinal theory, is in some form now accepted by practically all geologists, not as indicating absolutely the limitations of the occurrence of oil and gas but as expressing the general relations of their occurrence to geologic structure, subject to various modifying conditions. Other factors less well understood enter into the problem, such as the difference in the capillary attraction exerted between water and the rock particles and between oil and the rock particles and the differences in friction experienced by the two fluids in passing through the rock. There is much to be learned concerning the whole problem, but enough is known to make the study of any oil field of economic as well as scientific value.

If the rock containing the oil does not also carry water there is no force to impel the oil into the upfold or anticline. On the contrary, gravity tends to pull it downward and it collects in the adjoining downfold or syncline. This condition is found in some of the Pennsylvania fields.

Where the migration of oil is due to the pressure of dissolved or occluded gas in the absence of water saturation the oil will move in all directions until it is stopped by some impervious stratum, where accumulation takes place in apparent disregard of structure.

The simplest structure favorable to the accumulation of oil and gas is that of a symmetrical anticline having little or no pitch of the axis and moderately dipping flanks. If the requisite condition of porous oil-bearing rock adequately sealed by impervious beds is fulfilled and the strata are impregnated with water under moderate hydrostatic pressure, the hydrocarbons will, under ideal conditions, segregate in the axis of the fold and extend down the flanks a distance dependent on the quantity present. Farther down the flanks and in the troughs of the corresponding synclines water will as a rule be found. It is evident that, other things being equal, the extent of the productive area controlled by anticlinal structure is greater where the fold is broad and the dip of the strata on the flanks relatively low than where the fold is narrow and has steep flanks, for in the former case the gathering ground for oil and gas is much greater than in the latter. From the simple symmetrical anticline there are gradations on the one hand into domes pitching away from a central point and on the other hand through unsymmetrical folds to an extreme type in which one flank is vertical or overturned. In every symmetrical fold the boundary between an oil pool lying at the top of a fold and extending part way down the sides of the fold and the water saturating the rocks farther down is an approximately horizontal line, because as long as the fold is regular the water tends to rise to the same level all along it. If, however, there are minor irregularities on the sides of the fold these have their effect on the distribution of the oil, making the margin of the pool irregular or causing small pools to collect along the slope.

Structural features of other types are under certain conditions favorable for the accumulation of petroleum and natural gas. Among these may be mentioned monoclines, which present conditions favorable for the concentration of oil wherever there is a change in the rate of dip or an abrupt change in the strike of the rocks, shallow synclines where water is absent from the oil-bearing zone, and synclines where the oil and water are of nearly the same gravity. Unconformities where steeply dipping petroliferous strata are overlain by relatively impervious horizontal or nearly horizontal beds are also favorable. Faults are usually considered wholly unfavorable to the accumulation of oil and gas, and for areas where the dislocations are many and extensive this view is undoubtedly correct. However, in many places faults have quite the contrary effect. For instance, strike faults may cause a greater concentration of petroleum toward the crest of a fold, and dip faults in a series where there are many oil

sands may bring about communication between the different sands and have a notable effect on local production. In a series of uniformly dipping beds an oil sand which would normally crop out at the surface may be cut off by a strike fault and sealed beneath impervious beds and thus retain oil which would otherwise migrate to the surface and be dispelled. Moreover, faulting may produce fractured zones along which the oil or gas can migrate and in which it may collect. In a number of localities, as in some of the fields in Mexico, where intrusive dikes have pierced oil-bearing strata and consequently arrested the movement of the oil in certain directions, the petroleum has accumulated in apparent disregard of the structural features of the sedimentary series.

In many fields there is little or nothing at the surface to indicate the presence of valuable hydrocarbons below, but in many other fields there is ample indication of oil at the surface. The oil-bearing stratum itself may crop out and the oil ooze from it, giving to the rock a dark, greasy appearance and the odor of petroleum, or the oil may find its way to the surface from the oil pool below through some fracture of the overlying rock. Water charged with various salts or with sulphur may rise with the oil, so that a spring is formed, the oil floating as a brown scum on the surface of the water or in smaller quantity producing the brilliant iridescent sheen characteristic of petroleum. Gas may find its way to the surface and appear in "gas springs" or under certain conditions may produce the phenomenon of mud volcanoes. The place at which oil has come to the surface and evaporated through long periods of time may be marked by a deposit of asphaltum. In certain localities oil-bearing shales have been burnt to a pink or deep brick-red color or altered to a hard vesicular rock resembling scoriaceous lava. This metamorphism is due to the burning of the hydrocarbons that have impregnated the rock, and the presence of such rock therefore becomes an important surface indication of petroleum.

The stratigraphic occurrence of hydrocarbon minerals in the United States is by no means limited; on the contrary, petroleum in the solid, liquid, or gaseous form is found in greater or less quantity throughout the range of strata from the Cambrian to the younger members of the Tertiary series.

In general the commercially important accumulations of oil throughout the central and eastern portions of the United States are found in strata belonging to the Paleozoic era. In the great Appalachian field, which extends from the southern portion of New York along the western slope of the Alleghany Mountains to northern Tennessee, the accumulations of oil occur in strata ranging in age from early Devonian to late Carboniferous. In Ohio and Indiana petroleum is derived chiefly from rocks of Ordovician age, and in Indiana mainly

from Carboniferous strata. In the Mid-Continent field, which embraces Missouri, Kansas, and Oklahoma, the petroleum has accumulated in rocks of the Pennsylvanian and Permian series. In the Gulf field, which includes the Coastal Plain of Louisiana and Texas, the petroleum-yielding rocks are Mesozoic and Cenozoic in age, being assigned in part to Cretaceous and in part to Tertiary formations.

In the Rocky Mountain fields the productive formations range in age from late Paleozoic to late Mesozoic. The Wyoming fields present perhaps the greatest range of occurrence, yielding oil from strata belonging to the Carboniferous, Triassic, Jurassic, and Cretaceous systems. The Colorado and New Mexico fields thus far developed obtain their oil from strata included entirely within the Cretaceous, and the small quantity of oil produced in Utah is derived from rocks assigned to the Carboniferous system, although indications of oil are found at certain localities in the Jurassic and Cretaceous rocks.

In the Pacific coast region the important accumulations of oil are found chiefly in Cenozoic rocks, although in certain fields an output of local importance is obtained from late Mesozoic rocks. In Ventura County, Cal., the principal oil-yielding formations are classed as Tertiary and range in age from Miocene to Pliocene. Along the west side of the San Joaquin Valley the range is greater, the oil extending downward into the upper members of the Cretaceous system. In the Kern River field, on the east side of the San Joaquin Valley in Kern County, oil is obtained from rocks of late Miocene or Pliocene age. In Santa Barbara County the oil is derived chiefly from early Miocene rocks. In portions of Oregon and Washington small amounts of oil and gas have been obtained from rocks assigned to the Eocene and Miocene series.

Despite this wide distribution of fluid hydrocarbons the conclusion does not necessarily follow that accumulations of asphaltum, oil, or natural gas may be found in any area of sedimentary rocks, for such accumulations take place only where all the essential conditions governing origin, adequate storage facilities, and favorable structure are fulfilled.

CLASSIFICATION OF OIL AND GAS LANDS.

The immediate purpose of the classification of oil and gas land is to withhold from entry all lands containing valuable deposits of fluid hydrocarbons pending the enactment of adequate legislation providing for their disposition. The ultimate purpose of the classification is to determine the position and extent of the areas whose value for their deposits of oil or gas, whether proved by actual drilling or indicated by favorable geologic conditions, is greater than their value for agriculture or other purposes and to provide for a disposition of the deposits in accordance with this greater value.

Classifications are made by the oil section of the land-classification board. This section consists of three geologists and a chief geologist.

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Classifications are made by the oil section of the land-classification board. This section consists of three geologists, in addition to the chief of the board. Each classification is based on data submitted by a field geologist, who is called into consultation at the meeting at which his data are considered. Other geologists having special knowledge of the area under consideration may also be consulted. The factors observed by the field geologist are reviewed in detail, and his inferences and conclusions are subjected to the severest tests of experience and theory. Each factor which can be conceived as having a bearing on the accumulation and present distribution of oil within the area under discussion is carefully considered in all its relations before an attempt at classification is made.

The record data submitted by the field geologists consist primarily of a map or maps showing the facts observed in the field. On these maps surface contours and drainage are indicated and the details of the areal geology of the region are clearly shown. The position of all petroleum seepages and indications is recorded, as well as the location, by appropriate legend showing the results obtained, of each well drilled within the area examined. All determinations of dip and strike are shown, also the axial lines of all anticlines and synclines, with the direction and amount of pitch of each fold. The location of all land corners found is likewise noted, in order that the classification may conform to the established system of land surveys. Structure sections are necessary to explain complicated structural conditions and indicate the relative thicknesses of the formations and the position of the productive zones. Underground structure contours must be drawn to show the relative position of the principal oil-yielding zones above or below sea level, in order that the approximate depth of the oil zone beneath any desired point in the field may be readily determined when the elevation of the point above sea level is known. In a field where considerable development work has been done the preparation of the data should include the plotting of all available well records and the correlation, if possible, of the several oil-yielding zones.

The principal factors considered by the board in determining the classification of an area are the stratigraphy, the structure, the continuity and character of the oil sands, the quality of the oil, and the presence or absence of water. In many fields the productive sands are confined to a single geologic unit, the formations above and below being uniformly barren. It is therefore necessary to know not only the number and relation of the productive zones in a particular succession of strata but also the geologic system or series and, if possible, the formation or group to which these zones belong. The assignment of productive zones to a definite formation or group outside of which the strata are known to be barren constitutes an important step in the classification, the productive portions of the field being thus limited to the areas underlain by the petroliferous units and the areas not so underlain being at once disregarded as having no prospective value for oil.

As it is the structure of the petroliferous strata which largely determines the place of accumulation of oil and gas, it is apparent that a detailed knowledge of the structural conditions is absolutely essential to classification. In the classification of areas whose structure is anticlinal all lands are classified as oil bearing which lie along the axes of the anticlines or which are so located on the flanks that the oil sand underlies them within an arbitrarily chosen limit of depth. This limit may be the depth below which it is estimated that drilling can not be profitably carried because of mechanical difficulties, or it may represent the distance from the axis beyond which it is considered improbable that oil or gas in valuable quantities have accumulated. In monoclines similar considerations limit the distance down the dip to which classifications as oil land are carried. In the rarer synclinal accumulations the width of the zone classified as oil bearing depends mainly on what is known regarding the quantity of oil present.

The thickness and porosity of the reservoir rock are important factors to be considered with regard to the production and life of the wells, but their bearing on classification is subordinate, for classification is concerned with the boundaries of productive areas rather than with estimates of probable production. The continuity of the oil-bearing zone is, however, an important factor in classification, though, unfortunately, it is one whose exact value can rarely be determined, because of the difficulty of obtaining adequate data on the subject. In many areas of Tertiary rocks, where lateral variations in lithologic character within short distances are to be considered the rule and not the exception, changes in the thickness and extent of the oil-bearing zones must be expected, and although field examination may show the general trend of the variations in a certain region, local variations can seldom be predicted in advance of drilling. A factor of uncertainty is thus introduced, which may now and then result in an erroneous conclusion and give rise not only to adverse criticism of a particular classification but even to sweeping and unjust condemnation of the entire method of procedure.

The quality of the oil obtained in a given field is considered in classification mainly with regard to its bearing on distribution. In general the greater the specific gravity of the oil the slower will be its migration, the less complete its separation from the associated water, and the lower down on the flanks of the folds its resting place; and, conversely, the less the specific gravity the more rapid the rate of migration, the more complete the segregation, and the higher in

the folds the ultimate place of accumulation. Experience has shown that only under exceptional conditions may considerable accumulations of light paraffin-base oils be expected in monoclines, although in many places the monoclinal structure lends itself to the accumulation of heavy asphaltum-base oils.

The presence or absence of water in the formations of an oil-bearing region is a factor in the classification only as it affects the accumulation of the hydrocarbons, determining very largely their relation to the structure, as already explained. Whether or not it is present in the petroliferous strata must be known before a satisfactory classification can be made.

The maximum depth at which accumulations of oil or gas will warrant the classification of an area as oil land is a matter that demands careful consideration for each field. The factors that determine this depth limit are primarily the richness and the continuity of the oil-bearing zones, secondary consideration being given to the quality of the oil, present market conditions, and transportation facilities. Thus in certain areas where production is large and the oil-yielding zones are believed to continue productive to considerable depth, lands beneath which the productive zone lies at a computed depth of 5,500 feet have been classified as oil lands. On the other hand, in areas where the geologic conditions preclude a large accumulation of oil and indicate a doubtful continuity of the oil-bearing zones, depth limits as low as 3,000 feet have been fixed. That quality, market, and transportation facilities should receive only incidental consideration becomes evident when it is realized that deposits of low-grade oils that can not now be commercially exploited may, in the not distant future, as a result of improvements in methods of drilling and refining, become important contributors to the Nation's fuel supply; that the use of oil is practically just beginning, and it appears certain to build for itself a market far greater than it at present commands; and that with the advance of settlement or the beginning of production transportation facilities will be provided for fields now remote and essentially undeveloped. To many persons a maximum depth limit of 5,500 feet appears excessive, but to one who has acquainted himself with the rapid progress in well-drilling methods and machinery during the last decade this limit is far from unreasonable. In many of the California fields wells drilled to depths of 3,500 or 4,000 feet are by no means uncommon, and in foreign countries and at a few localities in the United States wells more than 5,000 feet deep have been drilled. In the Kern River oil field, California, one well has a depth of 5,185 feet; in the Midway field of the same State a well whose depth is slightly more than 5,000 feet is reported; and in the vicinity of Los Angeles a well was

recently completed at a depth of approximately 5,200 feet. In western Pennsylvania one well more than 5,500 feet in depth has been drilled, and another, not yet completed, has been sunk to a depth of more than 6,000 feet. The effect of a few more years of improvement in drilling methods on the development of deep-lying oil deposits can be inferred only from the history of the past, but in land classification, which seeks in a measure to foresee and provide for future conditions, this progress can not be ignored.

When a conclusion has been reached by the board as to the portions of the field presenting conditions favorable for oil and gas accumulation, when a depth limit of profitable extraction has been fixed, and when the boundaries of the favorable and unfavorable areas have been determined and translated into terms of legal subdivisions of the land surveys, withdrawal or restoration orders are prepared and forwarded by the Director through the Secretary of the Interior to the President for final action. Two general types of withdrawals are made—first, preliminary withdrawals, based on more or less meager information, and, second, withdrawals made after field examination.

The usual type of oil-land withdrawal order, based on field examination, closely resembles that used in the withdrawal from public entry of lands valuable for their phosphate content. An example of an order of withdrawal of phosphate lands is given on page 183. Two special petroleum reserves have been created in the State of California in order to retain in Government control bodies of oil-bearing lands containing what are believed to be sufficiently large reserves of fuel oil to provide for the future needs of the United States Navy. An example of an order creating a naval petroleum reserve is appended

DEPARTMENT OF THE INTERIOR,
UNITED STATES GEOLOGICAL SURVEY,
Washington, August 8, 1912.

The honorable the SECRETARY OF THE INTERIOR.

SIR: In accordance with your instructions to recommend for inclusion in a special reserve a compact body of public lands containing an ample supply of fuel oil for the use of the United States Navy, I have prepared and recommend for submission to the President the following order of withdrawal, involving approximately 38,068 acres in the Elk Hills, Kern County, Cal.

Very respectfully,

GEO. OTIS SMITH,
Director.

AUGUST 10, 1912.

Respectfully referred to the President with favorable recommendation.

WALTER L. FISHER,
Secretary.

ORDER OF WITHDRAWAL.

Naval petroleum reserve No. 1.

It is hereby ordered that all lands included in the following list and heretofore forming a part of petroleum reserve No. 2, California No. 1, withdrawn on July 2, 1910, from settlement, location, sale, or entry, and reserved for classification and in aid of legislation under the authority of the act of Congress entitled "An act to authorize the President of the United States to make withdrawals of public lands in certain cases" (36 Stat., 847), shall hereafter, subject to valid existing rights, constitute naval petroleum reserve No. 1, and shall be held for the exclusive use or benefit of the United States Navy until this order is revoked by the President or by act of Congress. To this end and for this public purpose the order of July 2, 1910, is modified and the withdrawal of that date is continued and extended in so far as it affects these lands.

Mount Diablo meridian.

T. 30 S., R. 22 E., sec. 24, all.
[Here follows the remainder of land description.]

WM. H. TAFT,
President.

SEPTEMBER 2, 1912.

The preliminary withdrawals are made as a first step in classification and are based on recommendations of Survey geologists or of field agents of the General Land Office. A few such withdrawals have been based on petitions filed by residents of the community in which the occurrence of oil is suspected. The purpose of the withdrawals is primarily to withhold the lands from disposition pending their examination and classification. Because of the lack of definite geologic data most of the preliminary withdrawals of necessity embrace areas larger than those ultimately found to be valuable.

As soon as practicable after preliminary withdrawal the lands are examined geologically, and from the data obtained in this examination, presented and considered as already described, decisions as to the probable productive and nonproductive portions of the area are made. The areas classified as nonoil land are promptly restored and become subject to entry and disposition as if no withdrawal had been made.

The following order illustrates the form in which such restorations are made:

DEPARTMENT OF THE INTERIOR,
UNITED STATES GEOLOGICAL SURVEY,
Washington, September 9, 1912.

The honorable the SECRETARY OF THE INTERIOR.

SIR: Field investigation by the Geological Survey indicates that the lands listed below do not contain deposits of oil or gas. The following order of restoration, which involves 183,626 acres, is therefore recommended for submission to the President for appropriate action. A small part of these lands is within national forests, but none are included in public water reserves, coal, phosphate, or power-site withdrawals.

Very respectfully,

GEO. H. ASHLEY,
Acting Director.

SEPTEMBER 21, 1912.

Respectfully referred to the President, with favorable recommendation.

SAMUEL ADAMS,
Acting Secretary.

ORDER OF RESTORATION.

Petroleum restoration No. 12—California No. 7.

So much of the orders of withdrawal made heretofore for classification and in aid of legislation affecting the use and disposition of petroleum lands, namely, reserves No. 2, No. 18, and No. 20, as affects the lands hereinafter described is hereby revoked, for the reason that the Director of the Geological Survey reports that the lands are not valuable for the purpose for which withdrawn.

And it is further ordered that all such lands not otherwise reserved or withdrawn are hereby restored to the public domain and shall become subject to disposition under the laws applicable thereto upon such date and after such notice as may be determined upon by the Secretary of the Interior.

Mount Diablo meridian.

T. 16 S., R. 11 E., sec. 21, N. ½ of SW. ¼, SE. ¼ of SW. ¼, S. ½ of SE. ¼.
[Here follows the remainder of the land description.]

WM. H. TAFT,
President.

SEPTEMBER 23, 1912.

The areas classified as oil land remain withdrawn pending the enactment by Congress of appropriate legislation for the disposition of oil and gas deposits.

PHOSPHATE LANDS.

USE OF PHOSPHATE.

Phosphorus is one of the mineral elements that are essential to plant growth and therefore necessary to make soils productive, and it is one of the three most likely to become exhausted by continued removal in crops taken from the soil. Work at the agricultural experiment stations in Illinois, Ohio, and Wisconsin has shown that lands under cultivation in these States during the last half century have been depleted of one-third of their original content of phosphoric acid. This depletion per acre annually is equivalent to the

phosphoric acid contained in 60 pounds of high-grade phosphate rock. At this rate 12,000,000 tons of high-grade phosphate rock, approximately four times the production in 1911, or one-third the total marketed production in the United States from 1867 to 1911, would be required each year simply to offset the depletion of the 400,000,000 acres of cultivated land in the United States, the question of increasing the present agricultural yield not being considered.

Phosphate or rock phosphate is a mineral substance made up of lime and phosphoric acid and is the principal source of the phosphate of commerce. Its value is becoming more apparent and more clearly recognized in the United States, not only through the decreasing yield per acre of cultivated lands but also through the discovery of the fact that some virgin lands are deficient in this essential to plant growth. The marketed production of phosphate rock in the United States increased from 448,567 long tons in 1888 to 11,000,693 long tons in 1911. The rock phosphate is used as raw rock flour (or "floats") or in the form of a superphosphate, which is made by treating the rock with sulphuric acid.

LANDS CONTAINING PHOSPHATE.

The commercially available phosphate deposits of the public domain are those in Florida and those of the western fields, which, so far as investigated at present, are confined to the States of Idaho, Montana, Wyoming, and Utah.

Deposits of phosphate in the Rocky Mountain States were first discovered in northeastern Utah and southeastern Idaho, in the vicinity of the Idaho-Utah-Wyoming line. From this locality the deposits have been traced south, east, and west halfway across the States of Idaho, Utah, and Wyoming and northward to the vicinity of Helena, in west-central Montana, so that the phosphate beds now known cover an area extending about 220 miles from east to west and 420 miles from north to south. Of course only a small part of this territory is underlain by deposits that are commercially valuable.

Deposits of phosphate rock exist also in Tennessee, South Carolina, and Arkansas, but these deposits are on lands that have passed into private ownership. The production of Tennessee is increasing, that of Florida appears to have about reached its maximum, the South Carolina output is diminishing, and the Arkansas deposits are of low grade. For these reasons the largest future production must come from the western fields, where the deposits are chiefly on the public lands, although Florida will remain an important factor in production for many years to come.

PHOSPHATE RESERVES.

In order to prevent the alienation of the phosphate deposits on the public lands until Congress shall provide a law for their disposition that will encourage development under conditions favorable to the public interests, the known phosphate lands remaining in Government ownership have been temporarily withdrawn from entry. The reserves thus created embrace lands in the phosphate belt of Florida and in Utah, Idaho, Wyoming, and Montana.

FLORIDA RESERVES.

The deposits in the Florida reserves include two important kinds of phosphate—the hard rock and the land pebble; the latter doubtless was derived from the former. Deposits of both these types are found near the surface and are mined after removal of the soil cover or overburden. The pebble deposits are fairly regular in thickness, but the hard rock occurs in irregular pockets in the limestone of which it is supposed to be a residual product. The pebble deposits cover a large area, mainly in southwest-central Florida; the hard-rock deposits are distributed through the northwestern part of the State.

The hard-rock phosphate is sold on a guaranty of 77 per cent of tricalcium phosphate (the bone phosphate of commerce) and the pebble phosphate on guaranties of 60 to 75 per cent.

The prospecting or geologic mapping of these practically flat deposits in a region of slight relief is in most places complicated by the presence of overburden, so that any investigation of undeveloped portions is conducted principally by systematic drilling.

WESTERN RESERVES.

The phosphate deposits in the western reserves consist of rock phosphate occurring in beds interstratified with other rocks, in much the same way as coal occurs. The beds over 4 feet thick containing 70 per cent of tricalcium phosphate are from one to three in number in different places. These are interbedded with yellowish to brown phosphatic sandstone and shale and here and there with thin beds of dark limestone. The shale contains from 25 to 60 per cent of tricalcium phosphate and is doubtless of future economic importance. The phosphatic series ranges from less than 6 feet to about 180 feet in thickness and usually lies between a light-colored sandy limestone of variable thickness and a white, brown, yellow, or dull-black cherty limestone averaging 225 feet in thickness. The chert overlies the phosphatic beds where the strata are in normal order, but in places the beds have been turned completely

over in the intense folding that has occurred. The phosphate deposits therefore not only lie flat but stand at various inclinations, and they lie at great depth except where the long-continued action of the elements has worn away parts of the rock folds. These folds are of two principal types—upfolds, or anticlines, and downfolds, or synclines. In some places the folding has been moderate in amount and the folds are long, regular wrinkles. In other places the folding was so intense and the wrinkles were so sharp and extensive that the beds are broken or "faulted" and come together in irregular order. Faults may and in many places do sharply separate phosphate from nonphosphate land, and where such faults are concealed by later deposits, such as gravels, they may lead to an apparently unwarranted difference in the classification of adjoining and seemingly similar tracts. Two 40-acre tracts in a section may in reality be underlain by phosphate and the remaining tracts may be barren, although the surface character of all may be exactly similar, so that it is necessary that the field examinations, the nature of which is more fully explained elsewhere, should involve more than a study of specific tracts.

The phosphatic series is composed of rocks which wear away easily under the action of the elements, and its outcrop is therefore inconspicuous; but the rocks immediately above and below it are resistant and in many places stand out in ledges that are easily traced. The field surveys on which the classification of the lands is based are made with sufficient detail and accuracy to determine the distribution of phosphatic beds relative to 40-acre tracts or other legal subdivisions, the thickness and character of cover, and the quality and thickness of rock phosphate. The determination of the factors last named has in places involved the actual prospecting of the deposits by deep trenches, the longest of which was over 400 feet long. Certain other preliminary surveys of a reconnaissance nature have been made in order to acquire data for withdrawals and preliminary modifications of the reserve boundaries.

The estimated quantity of high-grade rock (containing 70 per cent or more of tricalcium phosphate) included in the area surveyed in detail to date is more than 3,000,000,000 long tons, yet it is possible that such an estimate, based solely on information collected along the outcrop of the beds, may be excessive. Below the surface the brown phosphate of Tennessee rapidly becomes lean and grades into the phosphatic limestone from which the phosphate is supposed to have been concentrated by weathering. The phosphate deposits of the western reserves may ultimately be found to show a similar change, although they do not exhibit clear evidence of such concentration

but in the main have the characteristics of original bedded deposits, probably in part of purely chemical and in part of organic origin. They have therefore been inferred to have practically the same richness underground that they show at the outcrop. However, in view of the unproved value of the deeper portions of the phosphate beds it is advisable that they be sampled by deep prospecting before any plan for the final disposal of the lands is adopted. If such prospecting shows that the greater part of the rock included in the estimates is relatively of low grade it will be self-evident that the exhaustion of the phosphate resources is not so distant as it now appears and that the value of the outcropping portions that are now known to include high-grade phosphate rock is much greater than is at present suspected.

SUMMARY OF PHOSPHATE SITUATION.

The question of the future adequacy of our phosphate resources for our own needs had been mentioned by several authorities prior to the conference of the governors in 1908, in which the discussion of this and kindred topics drew public attention to the situation. At this conference the possibility that foreign investors might acquire the better-known and supposedly richer portions of our deposits was suggested, the wisdom of permitting the exportation of so essential a quasi-public commodity was questioned, and the desirability of an early examination of the available supplies was emphasized. In part as a result of these indications of public interest, in part as a continuation of the policy already adopted in reference to coal lands, and in part because of the legal dilemma existing in the western fields through the inadequacy of the laws governing the disposal of mineral land the Secretary of the Interior, on December 10, 1908, withdrew from entry about 7,000 square miles of public land in Idaho, Utah, and Wyoming, pending an examination of their phosphate resources. In the following summer the United States Geological Survey began the examination of these lands and the investigation has been continued up to the present time, some 4,000 square miles having been examined in a preliminary way and about 2,500 square miles surveyed in detail.

The first withdrawal was based partly on information collected by the Hayden Survey in 1877 and partly on later detailed and reconnaissance examinations made by the United States Geological Survey. Field work done subsequent to this withdrawal revealed the regularity and the character of the phosphate deposits, so that it has been possible not only to revise the estimates of the reserves in the area actually examined since the first withdrawal but also to make a closer interpretation of the information gathered by the earlier

surveys. These facts and relations are brought out in the following table:

Approximate area of phosphate lands, in square miles.

Year.	Reconnaissance surveys.	Detail surveys.	Total.	Withdrawn.	Restored.
1906				7,000	78
1908	1,000	800	1,800	600	3,000
1910	1,000	800	1,800	48	90
1911	1,200	800	2,000	48	237
1913	400	400	800	1,800	606
	4,600	2,800	6,400	9,446	4,497

CLASSIFICATION OF PHOSPHATE LANDS.

FACTORS INVOLVED.

As the phosphate deposits on the public domain exist as stratiform sedimentary beds or as residual deposits of the placer type, they are, as a rule, readily found and their extent may be determined by the ordinary methods of areal geologic mapping. In examining deposits of this type the geologic problems involved are chiefly structural. The purely economic considerations of accessibility, means of transportation, and nearness to market are highly important in the problem of establishing a commercial mine but are not involved in the classification of the land as phosphate or nonphosphate land.

The classification of a given tract as phosphate land is governed by the facts observed in the course of a field examination. A knowledge of the general geology of the region tells the examiner in what geologic environment the deposits may be expected, and a knowledge of the local succession of the beds tells him at what horizons and at what depths such deposits may be found in the tract examined. Before making a mineral or nonmineral classification of withdrawn phosphate lands it is essential to know exactly the distribution of the valuable deposits and to ascertain their relation to the legal subdivisions, so that the lands may be correctly described and classified. In making a classification it is also necessary to know the thickness and the number of the phosphate beds; the proportion of phosphoric acid (P_2O_5), or its equivalent expressed as tricalcium phosphate, that they contain; and the depths below the surface at which they occur.

The facts determined and recorded in the course of a field examination are shown on the township maps submitted by the field geologists to the land-classification board. If any of the data collected can not be represented on the maps they are supplied in the form of descriptive notes. One of the most essential factors to consider in the classification of any tract is the relation of the bed and its outcrop to that tract. If the rocks are in normal position—that is, if they have not been overturned or greatly disturbed by faulting—all the area underlain by rocks stratigraphically below the outcropping bed and therefore not underlain by the phosphate bed—may at once be classified as nonphosphate. In order to determine what lands are underlain by phosphate deposits it is necessary to work out from the recorded dips and strikes the structure of the field and to ascertain in what position and at what depth the phosphate beds lie. When these factors have been duly considered and the position of the phosphatic layer has been determined, it is necessary to know the regularity of the phosphate content of the bed, its variation in thickness, and the uniformity of its chemical composition from point to point in order to determine whether or not the tract contains a sufficient amount of phosphate to justify its classification as phosphate land.

Frequently in considering these factors it is desirable to make use of data of a confidential character which may have been procured in the course of the field examination. Such data, although used in determining the classification of the land, never appear on the map that is filed, but for all confidential sections, drill records, or other data only the location is indicated on the map and the material itself is kept separate from the general description and is not open to public inspection.

PRINCIPLES CONTROLLING THE CLASSIFICATION OF PHOSPHATE LANDS.

Lands that have been included within phosphate reserves because preliminary examinations indicated that parts of them at least contain valuable deposits of phosphate whose exact distribution could not at that time be ascertained are further examined as soon as practicable and all lands barren of phosphate are recommended for restoration. In order to determine what lands should be so recommended and what lands should be retained in the phosphate reserve pending legislation providing for the disposition of phosphate deposits, it is necessary to determine what is and what is not to be regarded as phosphate land. It is very evident that lands which contain phosphate beds only an inch or two in thickness or with a content of tricalcium phosphate that is only 2 or 3 per cent of the entire mass or lands beneath which the phosphate beds lie at depths so great that they can not be commercially mined should be considered nonphosphate land.

REGULATIONS FOR THE CLASSIFICATION OF PHOSPHATE LANDS.

In order that the restorations and withdrawals may conform as nearly as possible to the factors that are involved in determining

whether a given bed of phosphate possesses any actual or prospective value as a source of commercial phosphate, the following regulations were framed and have been applied in the classification of phosphate lands.

The principles incorporated in these regulations are to be used primarily for guidance in determining what lands will be recommended for reservation and what lands will be restored or excluded from future reserves. These principles, however, are based on a careful consideration of the factors which affect phosphate values and which may be involved when provision has been made for the disposition of the phosphate lands or of the deposits themselves. Furthermore, due regard has been given to such future developments as can be anticipated from present conditions.

Phosphate deposits shall be classified according to their thickness, their depth below the surface, and their calculated tricalcium phosphate determined from phosphoric acid content.

Lands underlain by beds of phosphate less than 1 foot in thickness or containing less than 30 per cent tricalcium phosphate or lying at a depth greater than 5,000 feet below the surface shall be considered nonphosphate lands, except as hereinafter provided.

A. Lands underlain by beds of phosphate 6 feet or more in thickness and containing 70 per cent or more of calculated tricalcium phosphate shall be considered phosphate lands if the beds do not lie more than 5,000 feet below the surface. The depth limit for beds containing 70 per cent of calculated tricalcium phosphate shall vary from 0 to 5,000 feet in direct ratio to the variation of thickness of bed from 1 foot to 6 feet. For beds containing less than 70 per cent tricalcium phosphate the depth limit shall vary from zero to the depth of a 70 per cent bed of any given thickness in direct ratio to the variation in tricalcium phosphate content from 30 to 70 per cent.

B. Lands underlain at depths greater than the depth limit given in "A" by horizontal beds of phosphate 6 feet or more in thickness and containing 70 per cent or more of calculated tricalcium phosphate shall be considered phosphate lands to a distance of 10 miles from the outcrop or point of accessibility from which they can be reached by a horizontal tunnel, which distance shall be decreased to 0 in direct ratio as the thickness decreases to 1 foot. For beds containing less than 70 per cent calculated tricalcium phosphate the maximum distance for any given thickness of phosphate bed shall be decreased to zero in direct ratio as the percentage of tricalcium phosphate decreases from 70 to 30 per cent. If the phosphate beds dip toward the outcrop or lie above the point of accessibility, they shall be included under this paragraph.

C. The maximum horizontal distance for any given thickness of phosphate bed shall be decreased from that given in "B" to one-fourth that distance in direct ratio as the depth below the outcrop or point of accessibility increases from zero to the limiting value given in "A." This limiting horizontal distance applies both to horizontal and to dipping beds, but in no case shall land be classified as phosphate land where the bed lies at a depth below the point of accessibility greater than that given in "A" or where the amount of barren tunnel and shaft work required to reach the phosphate bed would

be more than three-fourths of the total tunnel and shaft work required to mine the bed, 1 foot of lift being considered equivalent to 7.92 feet of haul.

D. Where the phosphate bed occurs at or near the surface so that the deposits may be readily mined by open-cut or stripping methods, the minimum thickness of a phosphate bed containing 70 per cent or more of tricalcium phosphate shall be 3 inches. For beds containing less than 70 per cent tricalcium phosphate the minimum thickness shall increase to 1 foot as the percentage of tricalcium phosphate decreases from 70 to 30 per cent.

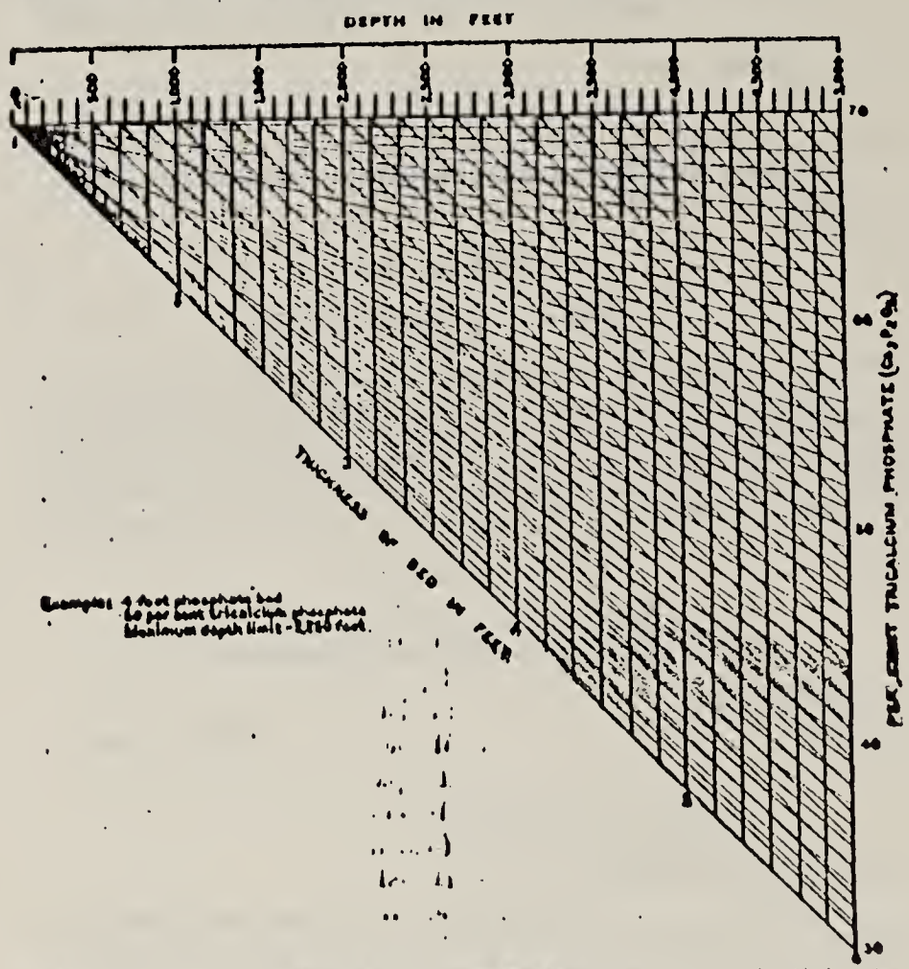


FIGURE 7.—Diagram showing depth to which phosphate deposits are classified under article A of the regulations.

PROGRESS IN CLASSIFICATION.

Classifications of the phosphate lands that have been examined are made according to articles A and D of the regulations. Recent field work in the closely folded phosphate region in the Western States and in the comparatively shallow deposits of Florida has shown that the attitude of the beds in these localities is such that it is not necessary to make use of articles B and C in classifying the lands. The classifications that are made according to the regula-

tions outlined in article D are comparatively simple, but those made under article A are much more complex and require considerable computation. In order to reduce to a minimum the computations involved in determining the maximum depth a given phosphate bed of known thickness and content of tricalcium phosphate may attain for the land to be classified as phosphate land, the accompanying diagram (fig. 7) has been constructed, by which each individual problem falling under article A can be readily solved.

All beds 6 feet or more in thickness are computed as 6-foot beds, and all beds having a content of tricalcium phosphate greater than 70 per cent are computed as 70 per cent beds. In order to determine from the diagram to what depth any phosphate bed whose thickness and content of tricalcium phosphate are known should be considered workable, the vertical line in the diagram that represents the thickness of the bed is selected and followed to its intersection with the diagonal line representing the percentage of tricalcium phosphate the bed contains. From this point of intersection the actual or constructed diagonal line is followed to the top of the diagram, where the maximum depth limit is given. Every 40-acre tract between the outcrop of the phosphate bed and the line where the bed reaches this depth limit should be classified as phosphate land.

Where the phosphate rock occurs in several thin beds or groups of beds sufficiently close together to be mined as a unit but with different percentages of phosphoric acid, all the material that can be mined as one bed should be taken, or in case part of it consists of barren rock that portion of the group that can be mined as a unit and will give the greatest amount of phosphate rock should be considered. Where more than one bed exists that can be mined separately without destroying the value of the other beds the land should be classified on the basis of each bed separately, all the lands being classified as phosphate land that can be so classified with reference to any one of the beds. This method of calculation gives the maximum amount of phosphate that can be obtained from the bed or group of beds and is the method used in determining what lands should be classified as phosphate land.

As a result of action of this type, based on field examinations made by the geologists of the geologic branch, withdrawals and restorations have been recommended from time to time.

Examples of withdrawal and restoration orders are given below:

DEPARTMENT OF THE INTERIOR,
UNITED STATES GEOLOGICAL SURVEY,
Washington, January 25, 1913.

The honorable the SECRETARY OF THE INTERIOR.

SIR: Investigations by the Geological Survey in the Florida phosphate region indicate that the lands listed below lie within the phosphate area and probably contain valuable deposits of phosphate. These lands were reported by the General Land Office in a letter, dated January 15, 1913, as vacant Government lands, or as unapproved State or railroad selections. Their withdrawal is in accordance with the procedure outlined and advocated in my letter of August 10, 1912. I therefore recommend the submission to the President of the following order of withdrawal, involving 76,851 acres.

Very respectfully,

GEO. OTIS SMITH,
Director.

FEBRUARY 3, 1913.

Respectfully referred to the President with favorable recommendation.

WALTER L. FISHER,
Secretary.

ORDER OF WITHDRAWAL.

Phosphate reserve No. 18—Florida No. 5.

Under and pursuant to the provisions of the act of Congress approved June 25, 1910 (36 Stat., 847), entitled "An act to authorize the President of the United States to make withdrawals of public lands in certain cases," as amended by act of Congress approved August 24, 1912 (Public No. 310), it is hereby ordered that the following described lands be, and the same are hereby, withdrawn from settlement, location, sale, or entry and reserved for public use.

Tallahassee meridian.

T. 2 N., R. 1 E., sec. 6, E. ½ of SW. ¼.
[Here follows the remainder of the land description.]

WM. H. TAFT,
President.

FEBRUARY 3, 1913.

DEPARTMENT OF THE INTERIOR,
UNITED STATES GEOLOGICAL SURVEY,
Washington, August 8, 1912.

The honorable the SECRETARY OF THE INTERIOR.

SIR: Field investigation by the Geological Survey indicates that the lands listed below do not contain deposits of phosphate. The following order of restoration, which involves 67,567 acres, is therefore recommended for submission to the President for appropriate action. Part of these lands are within coal withdrawals, but none are included in national forests, power-site or petroleum reserves.

Very respectfully,

GEO. OTIS SMITH,
Director.

AUGUST 17, 1912.

Respectfully referred to the President with favorable recommendation.

WALTER L. FISHER,
Secretary.

ORDER OF RESTORATION.

Phosphate restoration No. 6—Wyoming No. 2.

So much of the order of withdrawal made heretofore for classification and in aid of legislation affecting the use and disposition of phosphate lands, namely, reserve No. 4, as affects the lands hereinafter described is hereby revoked, for the reason that the Director of the Geological Survey reports that the lands are not valuable for the purpose for which withdrawn.

And it is further ordered that all such lands not otherwise reserved or withdrawn are hereby restored to the public domain and shall become subject to disposition under the laws applicable thereto upon such date and after such notice as may be determined upon by the Secretary of the Interior.

Sixth principal meridian.

T. 28 N., R. 119 W., secs. 5 to 7, inclusive;
sec. 18, all;
sec. 19, all;
sec. 30, all;
sec. 31, all.

[Here follows the remainder of the land description.]

WM. H. TAFT,
President.

AUGUST 17, 1912.

As a result of these orders, 3,201,527 acres of lands were included in phosphate reserves on January 1, 1913. The areas involved in these recommendations are indicated in the following table:

Phosphate land withdrawn, restored, and outstanding on January 1, 1913.

State.	Total withdrawals.	Restorations.	Outstanding withdrawals.
	Acres.	*Acres.*	*Acres.*
Florida	46,979	3,199	43,780
Idaho	3,216,834	1,157,778	1,058,056
Montana	274,861	.....	274,861
Utah	581,039	473,301	107,738
Wyoming	3,060,006	1,253,018	1,807,068
	6,177,811	2,886,284	3,201,527

LANDS BEARING POTASH AND RELATED SALINES.

GEOLOGIC OCCURRENCE OF THE DEPOSITS.

No potash deposits of proved commercial value are yet known in the United States. Indeed, large deposits of potash salts are rare anywhere. Much the greater part of the world's supply is obtained from deposits in central Germany, first known from their discovery near Stassfurt. The only other noteworthy deposit in the world is said to be that at Kalusz, Galicia, in northern Austria. Deposits of the Stassfurt type may eventually be found in the United States, but

the chances are perhaps greater that potassium-rich saline deposits in this country will vary widely from the German type in the character of the salts and in their mutual associations. It appears, therefore, that a discussion of the geologic occurrence of potash based on the Stassfurt type alone would be inadequate if intended to apply to possible deposits in the United States.

Potash in its soluble or most useful forms is almost universally associated with other soluble salts. Therefore it is to the natural saline residues and natural or artificial brines and bitterns that attention is directed in an exploration for soluble potash.

Great deposits of salines, especially those composed of sodium chloride or common salt, occur in many parts of the United States, but so far as known none of the important deposits now worked for salt contain an important percentage of potash salts. Saline beds occur at the surface in the arid regions of the West more abundantly than elsewhere. These occurrences include at least two types of deposits—the bedded salines included in stratified formations, which have commonly been tilted and otherwise displaced since their deposition, and the more recent saline deposits, which are to be found in the undrained playas and salt marshes of the Great Basin region.

The manner of formation of these more recent saline deposits is clearly revealed by the geologic record of the events that led to their accumulation and deposition. These events are so recent that the changes which are constantly taking place on the earth's surface have not yet obliterated or seriously obscured the evidence. This clearness and completeness of the geologic record justifies confidence in the correctness of the hypotheses concerning the manner of origin of saline deposits of this form.

Saline deposits in the Great Basin region, as elsewhere, are formed by the accumulation of the water-soluble constituents of the surface rocks of the earth's crust set free by that form of dissolution generally referred to as weathering. These salts thus freed are taken into solution by the rainfall and the ground waters and are gradually removed by the streams from the soils where they originate. Where these streams flow into inclosed basins with no outlet to the ocean, as is the rule in the Great Basin region, the dissolved salts are carried to the lowest part of the drainage area, where they accumulate. In the past, presumably because of greater precipitation than at present, these waters formed large lakes, which have since wholly or in part disappeared, and in the evaporation of these lake waters the salts have been deposited. Examples of saline deposits that have originated in this way in the low parts or so-called sinks of the inclosed drainage areas are common.

Saline deposits derived from the wash of continental areas normally contain among other constituents a certain proportion of

potash salts. As a whole, the quantity of potash associated with the sodium and other bases is so small—only 2 or 3 per cent of the whole—that the potash can not be recovered profitably for commercial use. However, as the potassium salts are somewhat more soluble than most of the other constituents of natural saline solutions, it is believed that they are generally among the last to be deposited when those solutions are evaporated. Owing to this selective action of evaporation it is probable that somewhere in the saline residues of completely desiccated lakes the potassium compounds will be segregated in much richer concentrations than elsewhere. This condition might not exist in natural saline deposits if the deposition of the salines were interrupted by some event which permitted the escape of the residual brines before all their constituents or final products were deposited. But apparently in the playas of the Great Basin no such event has interposed; hence all the constituents of the accumulated brines must still remain, and it is believed that in certain favorable places rich potassium-bearing salts exist.

Most of the lakes that formerly existed in the Great Basin have completely disappeared by evaporation. Vast quantities of saline residues must have been deposited by the final drying up of these lakes, but for the most part such deposits are not now seen at the surface. It is believed that the greater part of the salines deposited simultaneously with the disappearance of the lakes has since been buried by sediments carried into these basins by streams and deposited as alluvial wash or in later lakes that have occupied the original depressions. Older saline deposits elsewhere have been formed in a similar way.

If this hypothesis is sound, it follows that the probability of encountering saline deposits by drilling in the bottom of the desiccated lake basins is very great and that under favorable conditions potassium-rich salines will be among those encountered. It is hoped that such buried salines may not in all places be so deep as to be inaccessible.

Field work undertaken by the Government in the search for potash has heretofore been largely of an exploratory character and has not followed any general or established rule of procedure. A systematic study of brines, bitterns, and rock-salt deposit in all parts of the United States is included in the general plan. The Geological Survey has drilled a well approximately 1,000 feet deep near the center of the Carson Desert, in northern Nevada. This test is not regarded as completed. Elsewhere in Nevada and in California a number of shallow drill holes have been sunk in other ancient lake basins. Some of these experiments are yielding significant and possibly important results.

CLASSIFICATION OF POTASH-BEARING LANDS.

Congress, responding to the urgent recommendation of the President, had so amended the withdrawal act (p. 43) that deposits of potassium-rich minerals may be included in reserves until an appropriate law for their disposition is enacted. In view of the variety of such deposits in commercially available form and of their importance in industry, it is doubtless the intention of Congress, if the present search is successful, to make appropriate provision for their development and disposal. Meanwhile, as investigation by the scientists of the Government bureaus reveals promising localities, these localities, if they involve public lands, will be withdrawn from entry until their value as sources of potash can be demonstrated or disproved. If they prove to contain rich deposits the withdrawals will be maintained until Congress can act. Three reserves of this type have already been created by the President. They include 183,820 acres in Nevada and California.

The order of withdrawal by which potash reserve No. 2 was created is given herewith as an example of this type of action.

DEPARTMENT OF THE INTERIOR,
UNITED STATES GEOLOGICAL SURVEY,
Washington, February 20, 1913.

The honorable the SECRETARY OF THE INTERIOR.

SIR: Investigations by the Geological Survey in the State of California indicate that the lands listed below, which lie within a dry lake known as Searles Lake, probably contain valuable deposits of potash. I therefore recommend the submission to the President of the following order of withdrawal, which involves 69,840 acres.

Very respectfully,

GEO. OTIS SMITH,
Director.

FEBRUARY 20, 1913.

Respectfully referred to the President with favorable recommendation.

WALTER L. FISHER,
Secretary.

ORDER OF WITHDRAWAL.

Potash reserve No. 2—California No. 1.

Under and pursuant to the provisions of the act of Congress approved June 25, 1910 (36 Stat., 847), entitled "An act to authorize the President of the United States to make withdrawals of public lands in certain cases," as amended by act of Congress approved August 24, 1912 (Public No. 316), it is hereby ordered that the following described lands be, and the same are hereby, withdrawn from settlement, location, sale, or entry and reserved for classification and in aid of legislation affecting nonmetalliferous mineral deposits:

Mount Diablo meridian, California.

T. 24 S., R. 43 E., sec. 32, SE. ¼ of SE. ¼;
sec. 33, S. ½;
sec. 34, SW. ¼, W. ½ of SE. ¼, SE. ¼ of SE. ¼;
sec. 35, S. ½ of SW. ¼

An area bounded as follows: Beginning at the southeast corner of sec. 31, T. 24 S., R. 43 E.; thence west 2 miles; thence south 12 miles; thence east 9 miles; thence north 12 miles; thence west 2½ miles, more or less, to the south quarter corner of sec. 30, T. 24 S., R. 43 E.; thence west 4½ miles, more or less, along the south line of T. 24 S., R. 43 E., to point of beginning.

This withdrawal is made subject to all rights lawfully initiated under any valid mining locations made upon said lands so long as such rights are maintained in full compliance with law.

WM. H. TAFT,
President.

FEBRUARY 21, 1913.

As the geologic conditions under which potassium deposits are formed differ from those required for the deposition of the other nonmetalliferous minerals, except the related salines, special field methods have been used for their discovery. The steps to be taken in classifying lands as potash-bearing or potash-free subsequent to field examination are, however, identical with those followed in the classification of lands with regard to such other resources as phosphate and petroleum. The present laws do not provide for appraisal and sale, as in the case of coal lands, nor for lease.

MISCELLANEOUS NONMETALLIFEROUS MINERAL LANDS.

Some of the important minerals besides those already discussed are limestone, building and ornamental stones, cement materials, slates, glass sand, gravel, volcanic ash, diatomaceous earth, kaolin and other clays, fuller's earth, gypsum, borax, salt, sulphur, monazite, talc, soapstone, quartz, feldspar, cryolite, mica, gems and precious stones, strontium compounds, fluorspar, barytes, pyrite, graphite, asbestos, magnesite, abrasives, asphalt and other hydrocarbons such as gilsonite and ozokerite, mineral waters, mineral paints, and bromine, as well as guano and peat.

A great many of the so-called nonmetalliferous minerals contain metallic elements which either can not be extracted commercially or are regarded as of little or no value as metals but which by their union with nonmetallic elements from substances that are sought because of their nonmetallic properties. This is true of such minerals as corundum, an oxide of the metal aluminum, and gypsum, a sulphate of the metal calcium. Monazite is sought as the chief source of oxides of several rare metals. There are, however, so-called nonmetalliferous minerals whose metallic content is high and which may under certain conditions be regarded also as metallic minerals. A notable example is pyrite, a sulphide of iron, which is extensively employed in the manufacture of sulphuric acid because of its high content of sulphur. With advancement in industrial chemistry some minerals now classed as nonmetalliferous may be placed in the category of those which yield valuable metals and others now used may be discarded.

The geologic occurrence of the minerals named in the foregoing list is very diverse and the characteristics of the deposits containing them will therefore be referred to but briefly. Many of them exist in stratified or bedded form. Limestone, building stones, some cement materials, and some ornamental stones occur as sedimentary or metamorphic rocks. Slates are obtained usually from beds and are quarried in much the same manner as other building stone. Some glass sand is made by crushing a loosely consolidated sandstone or is obtained from beds of loose sand. Gravel is usually found in more or less bedded form in so-called "gravel banks." Volcanic ash and diatomaceous earth are ordinarily found in stratified deposits or beds. Clays, including kaolin and fuller's earth, result from the accumulation of the less soluble residues of the decomposition of preexisting rocks and minerals and are obtained almost entirely from bedded deposits. Some clays are obtained by dredging the bottoms of streams or lakes. Kaolin in its purest form results from the residual decomposition of pegmatitic feldspar in place.

Gypsum, borax, and halite, or common salt, are found in deposits that are related with respect to the manner of their geologic occurrence. They are found most abundantly in association with stratified rocks and are regarded as chemical deposits resulting from the evaporation of waters of inland seas and lakes. Some deposits of borax and halite occur in more or less stratified form in the beds of present-day salt lakes or marshes. Sulphur deposits large enough to be of economic importance occur as products of volcanic activity and are found near volcanic craters and also near some hot springs, either active or extinct.

Monazite, owing to its minute crystalline form and great weight, occurs in greatest quantity where it has been concentrated in placer deposits.

Talc and soapstone are very soft minerals which have presumably resulted from the alteration of other minerals. Soapstone, a talc schist, occurs with other rocks of various kinds, usually crystalline or metamorphic; talc occurs in beds intercalated in schistose limestone and in lenses or pockets in certain intrusive rocks.

Many minerals exist in veins or in the form of lode deposits. Quartz, feldspar, cryolite, mica, and some gems are found in veins in crystalline rocks. The strontium minerals occur principally in lenses, in granular and columnar masses, in bedded deposits, and in crystals that form nests and geodes in limestone. Fluorspar is found, as a rule, in veins in limestone, gneiss, schist, and sandstone. It is a common gangue of metallic ores, particularly those of lead, zinc, and tin. Barytes occurs in veins and beds associated with other ores, as well as in veins and masses in limestone.

Pyrite is found in fissure veins and along the bedding planes of sedimentary and metamorphic rocks. It occurs in various other forms in rocks of practically all kinds and ages. Graphite is found mainly in the older crystalline metamorphic rocks in embedded masses and veins, although in some places it occurs in beds.

Asbestos is an alteration product found in veins in older crystalline rocks. Magnesite is also generally regarded as an alteration product and is found in veins as well as in bedlike masses. Some abrasives, like corundum, emery, and garnet, occur in small crystals, principally in veins in igneous and metamorphic rocks.

Some asphalt impregnates sands, sandstones, and limestones and occurs in veins in these rocks. Other hydrocarbons, such as gilsonite and ozokerite, are found in veins or fissures, usually in sandstones.

Mineral waters are, of course, obtained from springs; and some common salt and sulphur, as well as the materials of some mineral paints, are obtained from deposits formed by the evaporation of spring water. Bromine is found in natural brines and bitterns.

Guano occurs in massive deposits, which in some regions are of considerable thickness. It is usually found in caves or other protected places. Peat results from the accumulation in bogs of plant remains that have undergone slight modification at the top, although if the deposit is thick its lower portion may have been reduced to a mass somewhat resembling lignite.

Sections 2320 to 2325, inclusive, of the Revised Statutes prescribe certain rules and regulations to govern the location and patenting of "mining claims upon veins or lodes of quartz or other rock in place bearing gold, silver, cinnabar, lead, tin, copper, or other valuable deposits." Section 2329 provides for "claims usually called 'placers,' including all forms of deposit, excepting veins of quartz or other rock in place." Thus, although the minerals in the foregoing list exist in nature in beds, in veins, in massive form, or as liquids, or even in more than one of these forms, the law divides them into only two great classes—those which occur in veins or lodes of quartz or other rock in place and those usually called placers, including all other forms of deposits. The distinctions as to mode of occurrence of these minerals in nature are considered in classifying as mineral or nonmineral the lands containing them; such distinctions are the primary factors that under the present mining laws must always be considered in determining the law under which the deposits may be acquired.

A large part of the information heretofore obtained by the Geological Survey regarding these minerals has been gathered in reconnaissance examinations and in connection with reports on mineral resources, with the result that in most of the areas examined much geologic information that would be necessary for land classification has not been obtained, although the data gathered are entirely adequate for the purposes for which they have been sought.

No particular method is at present followed in the field examination of deposits of these minerals, and there is no necessity for methods materially different from those pursued in detailed work on other metalliferous or nonmetalliferous deposits. Nor do the requirements as to the data to be gathered and the form in which they should be assembled differ essentially from those for other minerals. In addition to the location, a brief description of the nature and geologic structure of the rocks in which the deposits occur, with data regarding the thickness and succession of the rocks, their dip and strike, the extent of the deposits, and analyses of the material, are all important in the examination of bedded deposits. In the consideration of vein deposits data regarding the character of the vein, the systems and directions of joints, fissures, and fractures which may have formed the ore cavities, the dip and strike of the veins, the nature of the gangue material, and the wall rock are equally important. Statements of production are always desirable. The question of relative value—that is, of mineral value as compared with agricultural, power, or other values—must be considered in the classification of some lands because of the fact that the laws governing the disposition of certain minerals refer specifically to lands that are "chiefly valuable" therefor. Other factors, some or all of which are in many cases to be considered in judging the relative value of a mineral deposit, are the following:

1. Demand for the mineral, both present and future.
2. Character of the deposit; chemical and physical properties and extent.
3. Location with reference to market and in some cases to fuel supply.
4. Transportation facilities and rates.
5. Market price of the product.
6. Whether or not the particular deposit possesses other peculiar advantages rendering it more valuable than like deposits in the region and elsewhere.

The character of the deposits, their location, and the transportation facilities influence the cost of production by their effect on the cost of working the deposits, the cost of the plant, and in some places the cost of the fuel used in the manufacture of the product. These factors may also exert a most important influence on the selling price of the output by their effect on the cost of placing it in the market.

If the earlier geologic examinations had been made with a view to classification more precise instrumental work and a record of all the factors outlined as having a bearing on the deposits would have been required. No attempt has yet been made to systemize for purposes of land classification the available data regarding these minerals, and although the Geological Survey has prepared and sub-

mitted to the General Land Office many reports that have been a guide to action by that office and have been equivalent in many cases to nonmineral classification and in a few cases to mineral classification, no withdrawals and no formal classifications of lands because of their content of any of these minerals have been made. Although such minerals are useful and valuable, they are not in general of so great present or prospective use or value as coal and certain other nonmetalliferous minerals contained in lands for whose classification more specific provision has been made. Practically all minerals are of some value, but those of greatest value are naturally those which have the greatest present or future use and which are at the same time most easily or profitably marketable. Sand, for example, is of great use, but it is so common that in most localities it has almost no market value. Therefore, although the lands containing the nonmetalliferous minerals here discussed are, at the discretion of the President, subject to withdrawal and classification under the act of June 25, 1910, as amended by the act of August 24, 1912, there is no such public need for segregating these lands as there is for segregating lands containing deposits of such minerals as coal, oil, potash, and phosphate. Nevertheless, should it be deemed by the President to be in the public interest to withdraw or to classify as mineral land an area containing any of these deposits, because of a public need for a present or a future reserve supply, or with a view to preventing alienation of the mineral deposits under laws relating to nonmineral land, or as an aid to future disposition, his action would be based on a question of fact which it is the province of the Geological Survey to determine. So long as such withdrawal or classification is not deemed to be in the public interest, however, the land will remain open to exploration, discovery, occupation, and purchase under the mining laws unless Congress shall otherwise provide.

METALLIFEROUS MINERAL LANDS.

PURPOSE OF CLASSIFICATION.

The usual object in view in a consideration of the classification of nonmetalliferous lands as mineral land is to obtain their temporary withdrawal from entry, either to permit their appraisal, as in the case of coal land, or to await protective legislation, as in the case of potash or phosphate land. But metalliferous lands, as such, are not subject to withdrawal, and their classification is directed to other objects, which will be indicated by a brief account of some cases that have been considered by the Geological Survey.

Perhaps the most important case yet considered is that relating to the Northern Pacific land grant. Every alternate section in a strip extending 40 miles on each side of the right of way was granted to the Northern Pacific Railroad Co. to assist it in constructing a transcontinental line, but the act provided that the railroad company should not receive any lands that were valuable by reason of their content of mineral deposits other than coal and iron. It therefore became necessary to classify the entire grant with respect to its value for such deposits, and in practice the chief problem of this classification has been to determine the presence or absence of valuable metalliferous deposits. A great part of this classification was accomplished by specially appointed commissioners, and the Geological Survey had no part in the work until 1905. In that year a Survey geologist, accompanied by a field agent of the Land Office, examined a large portion of the grant lying in Idaho and Montana in order to obtain information supplementary to that on which the special commissioners had recommended a mineral classification of the greater part of this tract. The Survey, however, took no further action regarding that particular examination. The greater part of the tract was classified as mineral land as the result of a hearing before the register and receiver at Coeur d'Alene, Idaho, but this classification was set aside by the Commissioner of the General Land Office on petition of the Northern Pacific Railway, on the ground that it was based on insufficient field work. In 1910, therefore, an appropriation was made by Congress (act of June 25, 1910; 36 Stat., 703, 739) for a new and much more thorough examination, for making which the Commissioner of the General Land Office requested the services of members of the Geological Survey. Four parties, each comprising a geologist, a geologic assistant, and the necessary camp hands, devoted the field season of 1910 to the work, which was completed in the season of 1911 by three similar parties. The resulting classification, however, was not sufficient to decide the status of all the lands in controversy. The railway company had the right to contest classifications adverse to its interests and exercised this right as to many of the lands which, because they were classified as mineral, would be excluded from the railroad grant. Hearings on the contested classifications are held before the registers and receivers of the appropriate land districts. An appeal can be taken from the decision of these officers to the Commissioner, and from him to the Secretary. No final decision has yet (February 28, 1913) been rendered concerning any of the classifications of the Survey that are under contest.

The Survey has also been required to classify several Indian reservations, in whole or in part, either before or after the reservations were opened to settlement, the question in the one case being

the two main groups of cases in the detailed account of field methods that follows, despite their clearly distinct legal status. In most of the cases considered nearly all the kinds of information to be enumerated are used to a greater or less extent, and a geologic map of some kind invariably forms a part of the record.

The metalliferous deposits examined or looked for in most of the investigations preceding classification are veins, magmatic ore bodies, contact-metamorphic deposits, and bodies formed by replacement. In mining law these deposits are usually comprised in the term "lodes," and they may conveniently be so designated here. Some cases have to do with placer deposits, which are easier to examine and classify than lodes.

PRELIMINARY PROCEDURE.

As in the classification of nonmetalliferous lands and geologic field work in general, it is the duty of the geologist, before he takes the field, to gather information about the geology of the region to be examined and to provide himself with a base map. Other information that is especially desirable for work of this class relates to the location and status of the mining claims in the region. This is the only matter that requires further notice here, for the subject of base maps has been discussed elsewhere and the utility of geologic information is self-evident.

Plats and descriptions of patented mining claims are on file in the offices of the surveyors general of the several States and in the General Land Office at Washington. These show accurately the position of the claims with reference to land lines or location monuments. Provided with copies of these records, the examiner is able readily to find the patented claims. Less complete and accurate descriptions of the unpatented claims are filed in the offices of county clerks with the first records of location and the affidavits on assessment work.

FIELD WORK.

LOCATION AND TOPOGRAPHY.

The methods of location used in classification of this kind may be any of those described on pages 58–61. Some of the conditions of classifying metalliferous land, however, influence the selection of methods. The minute accuracy that characterizes much of the work on coal land is not often necessary in work on metalliferous deposits, and it is therefore feasible to use comparatively rough methods like that of the pacing traverse, which has been employed to a considerable extent. Another influential fact is that metalliferous land is more likely than nonmetalliferous land to be situated in mountainous territory. This is not obvious at first glance, but as metalliferous

deposits are most common where the geologic structure is complex, and as mountains are regions of upheaval and disturbance, the connection between topography and mineral wealth is real. The ruggedness of the areas in which the greater part of the work of classifying metalliferous land is done precludes the use of some methods that are especially adapted to work in a flat country, such as that in which distance is measured by the paces of a horse. The plane table is much used in open country, and stadia traverses of roads or streams are sometimes made for purposes of control.

INVESTIGATION OF PLACER DEPOSITS.

Geologic relations.—Although theory is not so important in relation to placer deposits as in relation to lodes, the physiographic history of the region may afford some guidance in the search for valuable placer ground, as the following considerations will show.

The most important geologic principle relating to placers is that concentration sufficient to make a valuable deposit has usually been the result of long and perhaps repeated working over of the gravels by streams. Therefore, other things being equal, well-washed deposits consisting in part of reworked older gravels would seem most likely to be rich in gold. Moraines, on the other hand, or glaciofluviatile deposits close to the place of their origin are unlikely to contain gold in sufficient concentration to be extracted with profit.

With respect to the distance of the gravels from their source, however, a happy medium is favorable. Too great proximity is inconsistent with efficient concentration, but the gold, except in extremely fine division, is not carried so far as the gravels, and too great remoteness from the source is therefore also unfavorable. Gold-bearing placers are likely to show a definite relation to such areas of auriferous bedrock as can be outlined; they are partly within those areas but extend beyond their borders as a sort of fringe.

Testing.—Although a knowledge of the general geology and physiography of the region may be a guide in the search for placers, the classification of land as valuable placer ground is always supported by more direct evidence, for the reason that the extent and value of a placer deposit can be determined much more closely than those of a lode. The examiner is expected to pan the gravels of all important streams in the area classified in order to obtain evidence regarding their possible value as placers and, incidentally, evidence regarding the gold content of the bedrock from which the placers have been derived.

Testimony of miners.—Owing to their necessary limitations, the tests made by the examiner must be supplemented as fully as possible by the testimony of miners and prospectors. From these the ex-

aminer may learn the tenor of the gravels, the probable extent of the pay dirt, and whether mining has been profitable. This testimony may be taken under oath, if the examiner has power to administer it, and should be corroborated, so far as possible, by assay certificates and other evidence. A geologist is able also to criticize the testimony in the light of geologic facts and would perceive, for instance, that an assertion that morainal gravels had been worked with profit would be in especial need of corroboration.

INVESTIGATION OF LODE DEPOSITS.

Kinds of evidence available.—The evidence which must determine whether land is to be classified as mineral because of lode deposits may be subdivided as follows: (1) General geology; (2) occurrence of valuable minerals or gangue minerals, disseminated or in veins, found in outcrops or float; (3) prospects and mines; (4) assays; (5) history of the region. Evidence of the first two classes is especially important in regions that have not been thoroughly prospected.

General geology.—Certain geologic conditions, such as fissuring of the rocks, are generally recognized as favorable to the deposition of ore bodies; others, such as lack of deformation and very young country rock, are unfavorable. But ore deposits are the result of a happy combination of several factors, and it may be difficult to consider these factors separately and determine their relative weight. Of two districts geologically similar, one may be rich and the other poor in ore deposits, because of some difference not readily perceived. The most general cause of such differences, perhaps, is the variation in what Chamberlin and Salisbury call the "diffuse regional concentration" of the several metals, whether in sediments or magmas, which is presumably the cause of metallogenic provinces.

Now, it is evident that geologic conditions, including obscure conditions that may be largely determinative, are more likely to be similar in neighboring than in widely separated areas. Neighboring districts are the more likely, for one thing, to be in the same metallogenic province. Therefore, in judging whether a given geologic condition is favorable or not, the investigator should especially inquire whether it seems to favor the deposition of ores in the vicinity of the area to be classified. For example, if ore bodies are known in one locality at the contact of a batholithic intrusion with a certain limestone formation, it is probable that they will be found at the contact of the same rocks in neighboring localities.

This reasoning by analogy may form one of the arguments in support of a mineral classification, but it can rarely be made the sole ground for such classification of a large area, which can hardly be successfully defended against a contest unless it is supported by some definite discoveries of mineral, made by prospectors or by the geologist himself. In fact, such concrete occurrences of mineral are likely to have even more weight in a contest than strictly geologic evidence. It may pertinently be asked, then, what special qualification for gathering the evidence required is possessed by a geologist compared with a prospector or any other intelligent observer.

The geologist would perhaps have no special advantage if unlimited time were allowed for the examination. In fact, however, the time is limited, it may be all too strictly. It is impossible within the time allowed to explore every square foot of the area, and therefore observation must be concentrated where deposits are most likely to be found. Now, in determining what places are best worth examination the geologist finds abundant practical use for his knowledge both of general and of local geology. His general knowledge teaches him that some geologic conditions are more favorable than others to the formation of valuable deposits, and he distributes his attention accordingly. He does not, for example, waste his time in looking for quartz veins in undisturbed rocks, knowing as he does that deformation and fissuring are necessary to the formation of veins. The special knowledge of the region which he may already have or which he is prepared by training to assimilate rapidly will enable him to recognize in the geologic environment of the ore deposits that have been found the details that are significant. If, for example, most of the known deposits of a district are the result of interaction between a limestone and an igneous intrusive, the geologist will presumably be quicker than a layman to recognize this fact and will explore with especial care the contacts between these rocks in areas near those which have proved productive. The geologist, in short, is better prepared than the layman to follow clues.

The shorter the time allowed for the examination the more decided the advantage of the geologist over the man without geologic training. An exploration sufficiently thorough to discover even a large proportion of the valuable deposits in the region to be classified is rarely possible, and the value of many of the deposits found must be doubtful before they are thoroughly explored. It is correspondingly important, then, that the fullest and most reliable inferences be drawn from the data obtained in the field.

The following paragraphs are intended to show what kind of geologic evidence the examiner seeks.

Country rock.—The broadest generalizations that can be made regarding the influence of country rock, as indeed regarding other geologic factors, are of negative character. It is safe to say that very young unaltered volcanic rocks or imperfectly consolidated sediments are unlikely to contain metalliferous lodes. Further than this, however, the probable richness of a formation bears no direct relation to

its age, for valuable deposits are found in rocks of all ages, from the Tertiary to the most remote.

In a particular district, however, the ores may show a preference for certain rocks. The favorable rocks may be those that contain minerals in a finely disseminated condition which may be valuable if they are anywhere sufficiently concentrated. Copper, for example, seems to be a constituent of some basic igneous rocks. Ready replaceability, or the power of reacting vigorously with mineralizing solutions, may be the determining favorable factor; and where the typical deposits of a district are replacements or contact-metamorphic deposits calcareous sediments are usually more favorable than others. Again, the presence of some constituent which acts as a precipitant may determine the concentration of a valuable mineral; organic matter probably precipitates gold under some conditions, and carbonaceous slates appear to be a common country rock of gold deposits. Finally, some purely physical feature may be determinative. The hard rocks of a district may be fissured to form breccias in which the ore-bearing solutions can circulate and deposit, while fissures in soft rocks would be clogged with impermeable gouge; and fissures which are large and persistent in massive rocks might ramify, on entering fissile rocks, into a multitude of small slips parallel to the bedding or cleavage.

Intrusions and metamorphism.—Although the nature and degree of the relation between igneous intrusion and ore deposition are still moot points, it is an established fact that ore deposits are especially abundant in the vicinity of intrusive contacts. Apart from stratiform deposits—such, for example, as those of iron oxide—ore bodies so remote from intrusive rocks as the lead and zinc deposits of the Mississippi Basin are rather exceptional, though not so exceptional as to make absence of intrusives a sufficient ground for classification of land as nonmineral. The general similarity in the distribution of ore deposits and of igneous rocks is particularly notable in the Western States. The presence of igneous intrusions must therefore be considered favorable, in general, to the deposition of ores.

Ore bodies related to intrusion are found both in the intrusive rock itself and in the surrounding sedimentary rocks. Those which are not contact-metamorphic deposits in the strict sense are not more likely to be at the immediate contact than at a considerable distance from it. The central portion of a very large batholith is likely to be barren, but the peripheral portion is commonly ore bearing, and all of the denuded portion of a small batholith or stock is likely to contain ore deposits, for none of it is far from the contact. Large dikes also form the country rock of many ore deposits. The ores are formed in the rocks cut by the intrusive, not only within but beyond the zone of contact metamorphism.

Structure.—The geologic structure of most mining districts is complex, and in regions of nearly horizontal unfaulted strata metalliferous lodes are scarce. Deformation, by giving rise to fault fissures and openings along bedding planes, probably determines the location of most lodes and is therefore favorable, in general, to the deposition of metalliferous ores.

Faulting is of greater importance in the formation of lodes than folding. Some faulting is doubtless a prerequisite to the formation of fissures transverse to the bedding, although fault fissures along which great displacement has been effected are not commonly filled with veins of commercial importance, for, inasmuch as they are likely to be choked with gouge and subject to repeated movement, they are less likely to be ore bearing than fissures along which the displacement has been slight or even imperceptible. Veins are accordingly looked for near and parallel to faults of large throw rather than along those faults themselves. That sort of faulting which gives rise to a rather coarse breccia is perhaps most favorable. At any rate, zones of brecciation afford the best clue for the tracing of small faults and are likely to be mineralized. They are therefore looked for and examined with especial care.

Folding, as well as faulting, may give rise to openings in which ores may be deposited. Saddle reefs constitute the most common type of deposits in openings thus formed.

Outcrops and float of lodes.—Outcrops of lodes afford the most direct evidence of mineral value that can be observed in the field apart from actual development, and they are therefore located and described with as great care as is practicable. If the deposits are veins, the direction and degree of persistence are determined if possible; this determination is particularly important if the classification must be close in the matter of location, but it is also important if in a neighboring region veins of a certain direction are known to be especially rich. Size and composition are other features noted. Size affects, of course, the degree of value, but the mineral content is of more immediate interest to the examiner.

In order to recognize lodes of probable value, the examiner endeavors to learn as much as possible concerning the appearance of the outcrops of lodes containing valuable minerals and familiarizes himself with the minerals likely to occur in the extremely oxidized portions of such lodes. Details regarding the surface indications along veins of proved importance in the region examined are sometimes obtained from prospectors and miners. The importance of these indications may be very great, for the minerals that make the lode valuable may not appear at the surface. More commonly than not the primary sulphides are represented at the surface by oxides or carbonates. The thoroughly weathered portion of a rich lode may even contain no

compounds of the valuable metals. This is especially likely to be true of copper deposits, whose upper portions are commonly transformed to rusty porous masses containing quartz, iron oxide, and other substances that resist the action of the weather. This material, which is known as iron capping or gossan, may contain small amounts of the bright blue and green copper carbonates, but on the other hand it may be wholly devoid of copper minerals. Many lodes that weather to a gossan and others that are composed largely of easily weathered minerals do not project above the surface and are therefore likely to be overlooked. If a lode is about as hard as the country rock its outcrop is nearly level with the general surface, and the position of a lode composed of soft, easily weathered material may be marked by a trench instead of a ridge. Many veins, again, have no outcrop; they are covered with soil, and their position is indicated only by float. It is therefore evident that both careful observation and intelligent inference are required to find the lodes and judge whether or not they are likely to prove valuable.

The proximity of lodes containing minerals in sufficient concentration to be commercially valuable may be indicated by the presence of such minerals or of gangue minerals associated with them, disseminated through the country rock or in the form of narrow stringers. Some minerals commonly so found are calcite, pyrite, siderite, and chalcopyrite. The more easily weathered minerals are likely to be represented by their oxidation products. Siderite, for example, is usually and pyrite commonly represented by pseudomorphs of hydrated ferric oxide. Extensive rusty staining of the country rock therefore causes the examiner to look for more specific evidence of mineralization. Other characteristic alterations of the country rock, such as leaching, chloritization, and sericitization, commonly occur along the walls of lodes and are therefore useful as clues.

Probably the great majority of prospectors' discoveries are made by following float[1] to its source, and mineral classification likewise may rest in large measure upon the evidence afforded by float. Time will not always permit the tracing of float to its source, and the examiner must then be content with inferences drawn from the character and situation of the float as he finds it. In any case the first step is to consider how the float probably reached its actual position. It may have done so by either (1) hill creep, (2) water transportation, or (3) ice transportation, or by a combination of any of these agencies.

1. Most float has been transported to its present position by hill creep, which is constantly active on every slope. Angular float, without marks of attrition, which does not lie in an actual or former stream

[1] This term is commonly applied by prospectors to all fragments of lode matter not in place, however transported; it will be used in this sense here.

channel or in a glaciated area has presumably come to its place by hill creep, and its source should be looked for, after the method of prospectors, by following it straight uphill. Normally the parent lode will be found somewhere between the point where the float was discovered and the top of the slope. If a search is impracticable the probable source may perhaps be inferred, on the same principle, within narrow limits, especially if a good topographic map is available; the source may thus be assigned to a particular section or even to a smaller subdivision. Moreover, the probable source can often be judged within narrower limits than those set by the distance from the point of discovery and the top of the slope. The small fragments of vein quartz, mingled with soil, which may be found almost anywhere in a region of deformed rocks, are likely to have crept downhill for a long distance; but large blocks of quartz thickly strewn over a small and fairly well defined area, especially an elongated area on a moderate slope, may reasonably be presumed to have come but a short distance from a vein. It is evidently necessary, then, to note fully, on the spot, the size and character of the float fragments as a help in judging the source; and their size may also roughly indicate the thickness of the parent lode.

2. Rounded fragments or bowlders of float, especially if in a stream channel in an unglaciated area, may be presumed to have been transported by water. Float of this character is also frequently followed by prospectors up the streams and slopes to its source. This process is too slow and difficult to be employed often by the examiner. But stream-transported float may ordinarily be assumed to have originated in the drainage basin where it is found, and scrutiny of the stream gravels may tell the examiner what to look for in a particular basin.

3. Float that has been transported by glaciers is subject to much the same conditions as water-transported float. It is usually to be recognized by its association with moraines and glacial sculpture but may sometimes be confused with float of the other two kinds. It is less feasible to find its source by systematic tracing than to find that of other float, but where the glaciation is local the parent ledge is likely to be near by and well exposed.

As placer deposits are really one form of float in the broadest sense, this may be the appropriate place to point out their value as indicating the auriferous character of the country rock of the drainage basin in which they are found.

It may be remarked, finally, that exceptionally, owing to migration of divides or their transgression by glaciers, float is found outside of the drainage basin in which it originated. This is most likely to be true of old stream gravels.

Prospects and mines.—An important part of the examining geologist's work is to note the location of all prospects and mines and to examine all of them, with the possible exception of those that are well known as producers. The most obviously useful data to be obtained from mining properties concern the value and visible quantity of the ore and the production if the property is producing. The examiner checks one against another his own observations, the information given by assay certificates and smelter returns, and the testimony of owners or mine officials, which may be in the form of an affidavit if it is thought desirable by an examiner who is empowered to administer an oath.

The information gathered from a prospect or mine may do much more than indicate the mineral or nonmineral character of the claim on which it is located and that of a little land in its immediate vicinity. The most useful clues may be obtained in openings which permit comparison between the appearance of a lode underground and that of its outcrop. By making these comparisons the examiner is much aided in recognizing the outcrops of important lodes that have not been opened, and by study of the geologic environment of prospected deposits he may form an opinion as to where others are most likely to be found.

Samples and assays.—Ore samples and assays showing their value give the most concrete evidence and have great weight at public hearings. To obtain abundant samples and assays, therefore, is one of the examiner's chief duties, and quantity of material is not more important than full information indicating its value as evidence. Samples collected by biased persons are taken only too often either from the best part of a lode or from the worst part, or even from the wall rocks; and the procuring of truly representative samples requires both judgment and honesty on the part of the examiner. Full records regarding the collection of the samples are indispensable. Even after every precaution is taken in the matter of collecting and record there may be much room for inference, for the weathered, superficial portion of a lode, which alone may be accessible, is sure to differ in tenor from the unweathered portion from which the valuable metals are partly or chiefly to be won. Where ores of the base metals are concerned, values may sometimes be estimated by inspection closely enough to dispense with assays. Usually, however, and especially if values in gold and silver are to be found, the classification of any large tract calls for many assays, and material to be assayed for precious metals must be collected with special precautions. Each sample must be large enough to suffice for several assays, so that any result whose accuracy is doubted may be checked, and the material must be broken up and well mixed to insure its homogeneity before it is divided into portions.

The Geological Survey does not make assays, not being provided with the proper equipment or a sufficient force. Its assay work is therefore done by custom assayers of established reputation.

History of the region.—The question sometimes arises whether the mining possibilities of a region are fairly represented by the extent to which it is developed. If a region contains few prospects and no mines, or if many of its prospects have been abandoned, is it or is it not because valuable metalliferous deposits are really absent? Some light may be shed upon this problem by the history of the region.

If the region has long been accessible and is known to have been well prospected, lack of development should have some weight against classification of land as mineral. It must be considered, on the other hand, whether local prejudice against some kind of country rock or gangue material may not have lessened the value of prospecting, or whether the region may not contain deposits of a kind that has not been looked for.

Abandonment of prospects may not always indicate the worthlessness of the lodes; it is sometimes due to the miner's failure to recognize valuable ores. Many metal prospectors have little knowledge of the appearance of ores other than those of gold, silver, copper, and lead and do not always recognize the secondary ores of copper, lead, and zinc. For this reason the dumps of abandoned mines may reveal ores of rarer metals or others not formerly used or commonly searched for by prospectors.

Mining methods and facilities often, of course, determine the success or failure of a mine, and it is proper to consider in every case whether abandonment may not have been caused by inefficient mining, crudity of methods, or difficulty of transportation. The transportation problem may be largely disregarded, for if a region develops good metalliferous deposits transportation is pretty certain to be provided in time, but the presence or absence of roads and trails has an important bearing on the accessibility of the region, which in turn is a factor of prime importance in deciding whether the absence of prospecting indicates the absence of valuable deposits.

BY-PRODUCTS OF MINERAL-LAND CLASSIFICATION.

VALUE OF COLLATERAL INFORMATION OBTAINED.

The process of classifying the public lands as to their mineral character involves the gathering of a large amount of information which is not only essential to the classification but valuable for other reasons. Furthermore, the accuracy and completeness of field observation necessary for classification afford an opportunity to record many facts which are entirely extraneous to the classification itself but

which may be now or at some later time of interest and value in other ways. These "by-products" of the process of land classification are of many kinds. Some are of value to home seekers and the public at large, others directly concern engineers and mining men, and still others are of present interest chiefly to scientists.

DATA OF DIRECT INTEREST TO THE PUBLIC AT LARGE.

While all information obtainable concerning the public domain is of ulterior interest to the people, information relating to such matters as the surface features, water supply, and character of the soil of a piece of land may prove to be of vital importance to the present or prospective settler. It is not practicable for the Geological Survey to make an exhaustive study of these features, but in the work of classification a certain amount of such information is always recorded. Thus, a map, supplemented by a written description, of each township examined for its mineral content is placed in the Survey files, showing in a rough way the agricultural character of the country. From these records it is possible to tell whether a section of land is suitable for dry farming or is adapted only to grazing, to obtain some idea of the number and size of the trees upon it, or to prepare a preliminary report as to its irrigability.

The field men engaged in work relating to land classification also record the position and size of all springs and water holes which they may find. This information is of direct value to the settler, but it also has another more general use. The more valuable agricultural lands of the public domain are rapidly passing into private ownership under the various settlement laws. It is recognized that most of the lands remaining are chiefly valuable for grazing or other uses not dependent on tillage, although the present laws do not adequately provide for their acquisition for these other uses. Congress has already given consideration to this problem and will doubtless reach a solution of it within the next few years. One of the most important factors to be considered in arriving at that solution will be the relation of the watering places to the range lands, for such lands can not be used without an accessible water supply. The accumulation of these data, therefore, in addition to being immediately useful to settlers and others, will be valuable in solving one of the public-land problems now confronting our lawmakers.

In studying and mapping a coal or phosphate bed it is necessary also to observe rather closely the geologic structure or attitude of the inclosing rocks. In some areas structure may have no bearing on mineral-land classification and yet may be valuable in determining the probability of obtaining a good well or of striking artesian water. The principles governing the flow of underground

water, though not generally understood by the layman, are yet comparatively simple, and a glance at the geologic map of a region may indicate at once the most favorable locality for sinking a well. As a minor illustration of the value of such information may be mentioned the fact that one of the geologists of the Survey had occasion during the summer of 1912 to advise two newly arrived settlers in the ceded lands of the Crow Indian Reservation, Mont., to sink their wells on the east side of a ridge rather than on the west side, as they had intended, because of the simple geologic fact that the rocks dip slightly to the east and the water follows down the dip, as is proved by the numerous springs on the east side and the few on the west. Such information is, of course, only of local application, but as the western country becomes more thickly settled and questions relating to city water supply arise, information of this kind gathered for the primary purpose of land classification may prove to be of considerable value.

Miscellaneous data of these types are utilized in various ways. Such of them as can with propriety be so used may be published in the bulletins in which the geologic material assembled in the course of land classification is made available for public use. Others, although not published and not used in mineral-land classification, are of the greatest value to the department in administering laws relating to nonmineral land, like the enlarged-homestead act, the desert-land law, or the Carey acts. Still others represent merely the accumulation of data likely to be needed if certain moot questions concerning public lands are to be decided by future legislation. All these actual or prospective uses, however, either directly or indirectly concern the public at large.

DATA RELATING TO PROSPECTING AND MINING.

Information regarding the character, location, and extent of each stratum of economic importance in the area examined forms a large part of the data on which classification is based. This information is published by the Survey in special bulletins or in the annual "Contributions to economic geology." A study of the map and of the plates of sections taken on the coal beds in any field, for example, will indicate to the prospective operator the most favorable location for a mine, and the text includes observations concerning the cover of the bed, the character of the roof and floor rocks, and the general structure, including faulting, of the inclosing strata.

Aside from the local and particular facts recorded for each area, as this work progresses the extent and character of each of the great mineral-bearing provinces are being accurately determined and more and more comprehensive and definite data concerning the mineral wealth available for the Nation's use are being gathered.

The study of the rock structure in an area is valuable not only in relation to its water supply, as has been indicated, but also as bearing on the occurrence of oil. The accumulation of oil and gas in the strata is governed by laws which are probably akin to those which direct the movement of water, and a knowledge of the rock structure is therefore, as a rule, of great assistance in the location of an oil well. Some new oil fields have been prospected and opened almost entirely on geologic evidence of this kind. It has also happened that the details of rock structure observed in a field examined merely for coal have been found to have an entirely new application and significance in subsequent prospecting for oil. In view of this close interrelation of geologic phenomena, therefore, the field geologist carefully records all the facts he observes in the course of his work, even though they appear to have no present bearing on the subject of land classification.

SCIENTIFIC DATA.

Data of interest at the present time chiefly to the scientist form another important "by-product" of the process of land classification. It is difficult, however, to select any group of facts as being of strictly scientific value alone, for new discoveries may at any time enlarge their significance and impart to them an unexpected economic importance. Many facts are, moreover, of equal interest to the pure scientist and to the engineer or the layman, so that while a great amount of scientific information has been collected in the work of land classification during the last six years, the purely economic value of much of it has already warranted the necessary expense.

Many data concerning the areal extent of different geologic formations have been gathered in the last few years and will be of use in connection with the geologic map of the United States which the Survey is now engaged in constructing. The stratigraphic relations of the formations, their composition, and their fossils constitute the only chronicle of conditions which have, at different times and divers places, existed on the earth. From this record some idea can be gained of the former geography of the country, of the great earth movements such as culminated in the formation of the Rocky Mountains, of the climatic conditions which formerly existed, and of the ancient plants and animals. These matters are at present chiefly of philosophic interest, but it has been by the accumulation of such facts in the past that science has been enabled to render valuable aid to mining and other industries. Furthermore, information of this kind, while perhaps of little present interest to the average layman, is of vital importance to the teachers of science in the universities of the country. As a case in point may be mentioned the recent discovery, by a Survey geologist engaged in the classification of coal

lands in New Mexico, of a great unconformity which separates into two formations a great thickness of strata that had hitherto been considered as a unit. This discovery is important not only on account of its strictly scientific bearing, but because it indicates that high-grade coking coal occurs in rocks of comparatively recent (Eocene) age.

It therefore appears that much important and diversified information is obtained in this way. Science is continually garnering facts against the time when their economic importance will appear, or when they may be correlated with other facts to furnish a broad hypothesis which may profoundly affect methods of prospecting or developing some mineral, such as oil. In addition, much local information of direct and immediate value to the mine operator or prospector is so gathered. Finally, the best obtainable record of the topography, water resources, and soils of the area examined is officially made. While the classification of public land is the immediate object of the work described in this bulletin, it is evident that such work, because of its exacting requirements as to accuracy and thoroughness, furnishes the best possible basis for valuable scientific generalizations.

CLASSIFICATION IN RELATION TO WATER RESOURCES.

GENERAL PRINCIPLES OF WATER UTILIZATION.

One of the most important factors in the development and use of the remaining public lands within the United States is water supply. The development of power, the extension of agriculture and grazing, the growth of mineral industries, transportation, and various other activities depend directly on the quantity and quality of the underground and surface waters in what is, generally speaking, an arid region. To dispose of or to administer the remaining public lands without reference to their water supply is to ignore that natural resource which will, perhaps more than any other, affect their future utilization.

Water is unique among the mineral resources of the earth in that, within natural limits, its supply is continually replenished and is therefore, in a large way, inexhaustible. That is to say, within the limits of the natural yield of a basin a certain minimum quantity of water will be available year after year in any river channel for irrigation, for city supply, or for power, as may be required. Aside from the inherent value of the water, the ownership of an important source of water supply becomes of the greatest consequence, for such ownership carries with it a measure of control, for an indefinite time, of all industries dependent on that particular source.

Statutes and court decisions both recognize that water should be devoted to its highest use, and the laws of many States provide for the condemnation of an inferior use in the interest of a higher one. Such laws generally recognize a municipal or domestic use of water as the highest which may be made, because of its necessity in the support of life. Next in order comes the use of water in agriculture for irrigation, whereby the available food supply is affected. The use of water for power, though important and valuable, is inferior to either municipal use or use for irrigation and may, in general, be condemned if necessary to insure higher utilization. The greatest value of a source of water supply at any particular time will depend, however, on the demands for domestic or municipal use, on the proximity of a tract of arable land adapted to agriculture, and on the quantity of power that may be developed and the availability of a market for it. Such value may change with the development of the country, making necessary the abandonment of established industries in order that the water may be available to supply a greater need. Changes in use will, however, follow the economic law, as the damage to established industries must be paid for, and to that extent the cost of the water for other use will be enhanced.

Important conditions are inherent in the use of water for various purposes. Its use for power affects neither its quality nor its quantity, but its use for irrigation depletes its quantity and its municipal or domestic use not only depletes its quantity but impairs its quality. Various uses may be and in many places are compatible with one another. In other places the conflict in use may be only partial. Many of the most advantageous sites for developing power, which, under conditions of modern long-distance transmission, are not dependent on a near-by power market for their value, are located in the upper portions of river basins, where the slopes are steepest and where demands for other use are not likely to be made. Under such conditions the water may be utilized in a power plant or a series of power plants and still be available for other purposes by the sacrifice of only so much of the power head as may be necessary to obtain adequate pressure in the pipes of the city water mains or to maintain the elevation of canals required to cover irrigable lands. In similar manner water that has been used for a municipal supply may still be available, as sewage, for a certain amount of irrigation. The equalization of the stream flow in order to insure a continuous output of power will in general increase the value of the stream for municipal use. The use of water for irrigation, on the other hand, is limited to the growing season and requires the concentration of flow in accordance with the needs of crops during that season. The complete utilization for irrigation of a stream whose flow has been equalized for power will make necessary storage below the power plant of the

flow of the nonirrigation season in order to render it available for the irrigation of crops in the following growing season. The practicability of such storage and redistribution of flow will depend on local topography and must be determined for each locality. The conditions which affect the present and future practicable utilization of water are therefore very complicated, and the classification of land as regards its water resources is correspondingly difficult.

In general the development and use of valuable power sites involves the construction of expensive systems for transmitting the power to distant markets and distributing it among small customers. A water-power development can be most fully utilized and therefore has its greatest value when connected into a system containing other hydroelectric or steam-power plants, because a large system will generally have relatively uniform power requirements on account of the varied use of the power and also a relatively flexible power output on account of the steam plants and of the storage capacity which may be available in connection with some or all of the water-power plants. In view of these conditions the combination of power plants into big systems is natural and tends to more economical and more complete utilization of the power resources. As a duplication of such a power system in any territory is uneconomical and in general is impracticable, a monopoly of the power market results, and such monopoly, if subject to proper public control, should be encouraged. Monopolistic tendencies in the control of water resources entail difficulties and dangers that have been recognized by Congress, as manifested by the laws governing rights of way, especially for the purpose of developing and transmitting power, on or across the public lands.

The protection of the people against the possible bad effects of monopoly and the retention of control of the use of this important source of power, which may be expected to increase in value with the decrease in available fuels, is at present accomplished by the United States through ownership of the land which is required for the use of the water resources. Congress has provided no means for the alienation of power lands as such and has sanctioned their use for commercial purposes only under a limited permit revocable by the secretary of the department having jurisdiction. It provided for rights of way for power-transmission lines under the same law but by a later act has authorized a fixed tenure for a period not exceeding 50 years.

CLASSIFICATION OF WATER-POWER SITES.

PRELIMINARY WITHDRAWALS.

The classification of lands as water-power sites and their reservation under the acts authorizing withdrawals is in general first made in the absence of detailed examination to determine power value and

is of a preliminary or tentative character. Examination in the field provides a satisfactory basis for final classification and adjustment of withdrawals. The following paragraphs relate more particularly to preliminary classification and withdrawal but describe also the routine procedure followed and records prepared in all withdrawals for power-site purposes.

The principal steps taken in connection with the making of power-site and reservoir withdrawals are as follows:

1. Initiation of search for possible power or reservoir sites. The possibility of the existence of valuable power resources is brought to the attention of those charged with the duty of recommending withdrawals through general probability that such sites may exist, through requests for report on the possibility of there being such sites, or through information as to the possible existence of such sites derived from reports of field employees of the Geological Survey or other offices, from news items, from newly published maps, from the filing of applications for rights of way, and from other sources.

In general the initiative in the premises is taken by the Geological Survey, but it not infrequently occurs that some power company intending to make surveys for a hydro-electric development in new territory requests the withdrawal of the lands likely to be occupied. The purpose served by withdrawal of such lands is two-fold. The valuable power sites that might otherwise be alienated as nonmetalliferous claims, timber and stone entries, agricultural entries, or for some other purpose, are retained in public ownership, and the company or person eventually developing the resource, presumably but by no means necessarily the one who requested the withdrawal, is protected from the intervention of other rights and has merely to acquire the necessary rights from the United States instead of from the United States and a host of persons who might otherwise have succeeded to ownership of the land.

2. Estimation of character and value of probable development and approximate description of the lands under consideration. This step involves an examination of existing data on stream flow and rainfall, as well as of maps, engineering reports, and all other available sources of information. In some cases information definite and conclusive in character may be brought to light. On the other hand, it frequently happens that estimates of stream flow must be based on nothing more reliable than conditions of run-off in basins many miles distant and that estimates of available head for power development must be derived from elevations at scattered points culled from railroad folders and similar data of doubtful applicability.

3. Examination of status of lands and definite description of lands to be included in the order of withdrawal. The lands presumed to be valuable for power or reservoir sites are platted on township plats

of the public survey or tracings of them, and the status of the lands as to ownership is ascertained by examination of the records of the General Land Office and indicated on the township plats or tracings. All patented lands are eliminated from further consideration. Lands which are covered by location or entry but title to which still remains in the United States are included in withdrawals to the end that the order of withdrawal may become effective if for any reason the lands do not proceed to patent. Such withdrawal in no way affects the rights of an entryman who proceeds with the acquisition of his claim in accordance with the law, but it immediately becomes operative in case the claim is abandoned or for any reason becomes invalid.

Definite description of the surveyed lands to be withdrawn is made by legal subdivisions in conformity with the official survey. Unsurveyed lands are described by townships and some lands in townships that are partly surveyed by sections, in accordance with the probable protraction of the public survey; also by distance from the stream or streams having value as a source of power, in some such phrase as "all land within half a mile of Snake River."

All withdrawals are so made as to include the least area that will effectively protect the resources involved. Where data are meager or defective the withdrawals are at first necessarily of relatively great extent but are eventually reduced as more definite and reliable data are acquired. The area of the land to be withdrawn in each township is compiled from the plats of the public survey, or estimated for unsurveyed lands, and the total area of the withdrawal is computed.

4. Preparation of order of withdrawal. The draft of a formal order of withdrawal is next prepared, together with a letter to the Secretary of the Interior transmitting the order and recommending its approval. On approval by the Secretary of the Interior orders of withdrawal are transmitted to the President for his consideration and become effective on his approval. The following order is typical of the present form of withdrawals under the acts of June 25, 1910 (36 Stat., 847), and August 24, 1912 (37 Stat., 497):

DEPARTMENT OF THE INTERIOR,
UNITED STATES GEOLOGICAL SURVEY,
October 18, 1913.

The honorable the SECRETARY OF THE INTERIOR.

SIR: In accordance with your general instruction, I recommend the withdrawal for water-power sites of the following areas, involving 240 acres. This order of withdrawal includes no lands covered by enlarged-homestead designations.

Very respectfully,

GEO. OTIS SMITH,
Director.

OCTOBER 10, 1913.

Respectfully referred to the President with favorable recommendation.

SAMUEL ADAMS,
Acting Secretary.

ORDER OF WITHDRAWAL.

Power-Site Reserve No. 209.

Mill Creek, California.

Under and pursuant to the provisions of the act of Congress approved June 25, 1910 (36 Stat., 847), entitled "An act to authorize the President of the United States to make withdrawals of public lands in certain cases," as amended by the act of Congress approved August 24, 1912 (37 Stat., 497), it is hereby ordered that the following described lands be, and the same are hereby, withdrawn from settlement, location, sale, or entry and reserved for water-power sites:

Mount Diablo meridian.

T. 26 N., R. 1 W., sec. 24, SE. ¼ of SE. ¼;
sec. 26, SE. ¼ of NE. ¼, SW. ¼ of NW. ¼, NW. ¼ of SW. ¼;
sec. 32, S. ½ of SW. ¼.

WM. H. TAFT,
President.

OCTOBER 18, 1912.

Orders of withdrawal affecting lands within Indian reservations, made under sections 13 and 14 of the act of June 25, 1910 (36 Stat., 855, 858), are forwarded to the Secretary of the Interior through the Office of Indian Affairs. The following order illustrates the form in which such withdrawals are now made:

DEPARTMENT OF THE INTERIOR,
UNITED STATES GEOLOGICAL SURVEY,
Washington, May 23, 1913.

The honorable the SECRETARY OF THE INTERIOR
(through the Commissioner of Indian Affairs).

SIR: In accordance with your general instructions, I recommend the withdrawal for water-power sites of the following areas, involving approximately 6,817 acres (in the Blackfeet Indian Reservation).

Very respectfully,

H. C. RICES,
Acting Director.

JUNE 18, 1913.

I concur in the above recommendation.

R. G. VALENTINE,
Commissioner of Indian Affairs.

ORDER OF WITHDRAWAL.

Power-Site Reserve No. 275.

St. Mary River Tributaries, Montana.

It is hereby ordered that the following described lands, valuable for power sites, be, and the same are hereby, reserved from location, entry, sale, allotment, or other appropriation in accordance with the provisions of the act approved June 25, 1910 (36 Stat., 855), and that no trust or fee-simple patent be issued as regards these lands until further order:

Montana meridian.

[Description of lands.]

SAMUEL ADAMS,
First Assistant Secretary.

JUNE 23, 1913.

Withdrawals of this form receive the concurrence of the Commissioner of Indian Affairs before being forwarded to the Secretary of the Interior and become effective on approval by the Secretary, no action by the President being contemplated by the law.

Copies of approved orders of withdrawal are furnished to the Geological Survey, to the Office of Indian Affairs if affecting Indian lands, and to the General Land Office, and notification thereof is sent to the local land office of each district in which the reserved lands are located. Notation of the withdrawal is thereupon made on the tract records of the General and local land offices. Thereafter entries inconsistent with the purpose of the withdrawal, except under the mining laws pertaining to metalliferous minerals, are rejected. Modifications of a withdrawal may, however, be made to permit the allowance of an application that will subserve the purpose of the withdrawal or that involves a more beneficial use of the land than could be had under the purpose of the withdrawal. Withdrawals therefore in no way interfere with the proper development of the resources involved but tend toward their most complete and beneficial utilization.

5. Preparation of minutes. At the time each order of withdrawal is prepared minutes are written setting forth the object sought to be attained by the withdrawal, the extent and value of the resources involved, the data on which the withdrawal is based, and other pertinent facts. Orders of withdrawal are numbered consecutively in chronologic order, and successive withdrawals on any stream are also given consecutive numbers in connection with the stream name. The various sets of minutes for withdrawals on any stream therefore constitute a concise statement of its value for power or reservoir sites and of the data relating thereto.

6. Office records. When notice of the approval of an order of withdrawal is received at the Survey, the withdrawn area is plotted and numbered on a General Land Office State map. A township card is prepared for each township affected, showing the location of the stream and indicating the legal subdivisions withdrawn and the number of the withdrawal. If more than one withdrawal is made in a township, the card is prepared so as to show the withdrawals separately and constitutes a graphic record of all withdrawals and restorations of withdrawn lands. The numbers and dates of recommendation and approval of all power-site withdrawals and restorations

involved are tabulated on the back of the card. The front of a typical township card is shown in figure 8.

In a ledger kept for withdrawals and restorations are noted, when the order is prepared, the number and area of the withdrawal or restoration and the date of the recommendation of the Geological Survey. The date of approval is also noted in the ledger when the copy of the approved order is received.

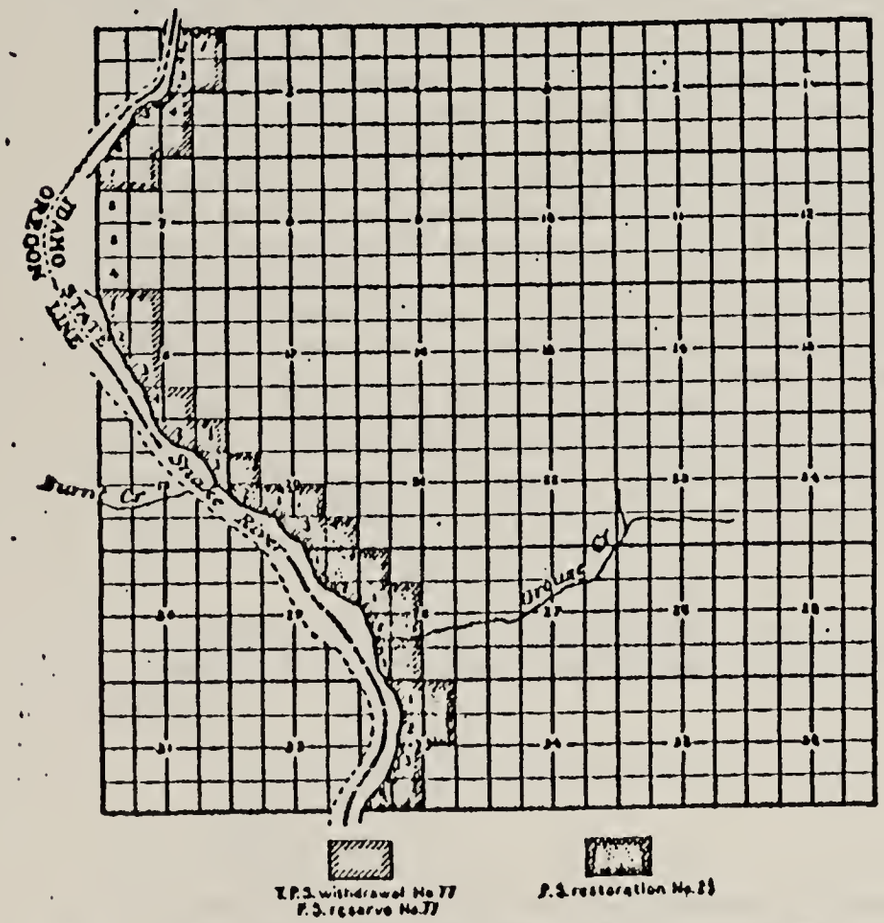


FIGURE 8.—Typical township card illustrating action taken by United States Geological Survey on power sites.

The complete record of the Survey relating to a power-site withdrawal consists of the following items:

(a) Order of withdrawal, filed by withdrawal number and therefore chronologically.

(b) Minutes, filed by number of withdrawal and therefore chronologically.

(c) Township plats showing status of lands as to ownership, filed in binders by number of withdrawal and arranged by principal meridian, range, and township.

(d) Township cards showing the extent and date of withdrawals and restorations, filed by States and arranged by principal meridian, range, and township.

(e) Mounted State map on which withdrawals and restorations are platted.

(f) Withdrawal ledger in which is kept a chronologic record of withdrawals and restorations showing the number, area, date of recommendation, and date of approval.

METHODS OF FIELD EXAMINATION.

DIVERSITY OF CONDITIONS.

The examination of lands and conditions along any stream for the purpose of locating a feasible power site is a fairly common and well-defined engineering operation. The examination of lands and conditions for the purpose of classifying the lands according to "power value," as the expression is interpreted in this bulletin, is quite another matter. In the first case, the effort is made to locate one or more sites that appear best adapted for development under the prescribed conditions of cost and prospective market which prevail at that particular time. The study is concentrated on the lands that will be involved in that particular development. In the second case, all the lands in public ownership adjoining or near the stream are presented for consideration, and the problem is to determine whether any or all of these lands could be used in the development of any feasible power site. Moreover, the feasibility can not be settled on the basis of present limitations of development but must be determined according to what are believed to be the limitations of a future day, when water power will be a more vital factor in our economy than it is now and when, by reason of increased demand, a development whose unit cost would now be too great would become thoroughly practicable. Power sites are classified according to their future possible utility as well as according to their present value.

There are other features which still further broaden the scope of an investigation of the kind here described. It is necessary to determine whether the lands examined may not be more beneficially devoted to the use of water for domestic supply or for irrigation than for power, and whether their use for power may not be prejudicial to the other uses at the site in question or at some other site more or less remote.

It must also be determined in many cases whether the land itself, irrespective of any distant lands which may be served, is of more value for agriculture or as a town or manufacturing site than as a power site. Such a consideration applies especially to lands that may be suitable for storage reservoirs. Usually the civic, industrial, or rural improvements that have previously been made in a reservoir site largely control the decision on this point, but the cases in which such influences are absent are still relatively frequent. Therefore

the field of investigation again spreads beyond the actualities of the present and an estimate of prospective events must be made.

Finally, it must not be forgotten that human activities are not confined to the utilization of water—that a community which produces must, if its products are of value, have suitable means of transportation. Therefore it frequently occurs that consideration must be given to the relative usefulness of a piece of land as a power site or as a right of way for a railroad. In some places the bottom of a canyon that is suitable for power development or a basin that is suitable for a reservoir is also an advantageous railroad route. Although it is usually possible to locate an alternate railroad route, the cost of utilizing it may be so great as to outweigh the advantages that may accrue from development of power along the stream. It is thus necessary to appraise the relative values and comparative costs and choose the course that is or is likely to become of the highest human benefit.

The classification of lands for water-power sites therefore requires a broad perspective, and it comprehends the study of so many variable conditions and prospective changes in public demand that mistakes are easily made and mature consideration is always necessary. Field examination naturally falls into two classes. The first is reconnaissance, made in response to urgency. The second is final and detailed and involves all the precision of instrumental work and the careful deductions made possible thereby.

RECONNAISSANCE EXAMINATION.

A suitable report on a water-power site classification should cover as many of the subjects listed in the following syllabus as may be relevant:

I. Sources of data used in report:
  1. Personal examination—route followed and time consumed.
  2. Water-supply papers.
  3. Maps.
  4. Reports of engineers.
  5. Miscellaneous.

II. General introductory description, including location as to State, rivers, cities, township, and range.

III. Description of the power developments and possibilities on the river, showing by sketch on best available maps location of dams, power canals, and power houses already constructed and possible location of these essential features for other power developments. Ownership of plants already constructed and use made of the power.

IV. Physical characteristics:
  1. Topography at dam site.
  2. Relation of tract to a possible power development described under III above.
  3. Head available, how secured, whether by dam or by dam and canal.
  4. Character of dam sites, holding ground for canals, and site for power house.

V. Water supply:
  1. General description of drainage area.
  2. Actual records if available, showing maximum, minimum, and mean discharge for each month, also absolute seven-day minimum for the year.
  3. Storage already developed.
  4. Storage possibilities:
    (a) Location of reservoir sites.
    (b) Height of dam.
    (c) Capacity of reservoir.
  5. Prior water rights above and below power site.
  6. Ice conditions during winter months:
    (a) Without storage.
    (b) With storage.

VI. Possible power development:
  1. Horsepower at wheel shaft (without storage).
  2. Horsepower at wheel shaft (with storage).

VII. Cost of power development:
  1. Cost of diversion or forebay dam.
  2. Cost of canals.
  3. Approximate cost of complete installation per horsepower developed:
    (a) Without storage.
    (b) With storage.

VIII. Market for power:
  1. Present.
  2. Future.
  3. Length of transmission lines, etc.

IX. Suggestions and recommendations:
  1. Relative to lands withdrawn.
  2. Relative to other public land which has or may have value for development or transmission of power.

X. Appendixes:
  1. Water-supply records.
  2. Maps.
  3. Pictures.

Before entering upon field work the hydraulic engineer should collect all available topographic and hydrometric data relating to the stream under investigation. For many streams the topographic data may be obtained from the United States Geological Survey topographic sheets, the United States Land Office township plats, county and other maps, or railroad location surveys and profiles. Study should also be made of the precipitation records collected by the United States Weather Bureau and the river-discharge records made by the United States Geological Survey and by private citizens. After obtaining in advance as much information as may be available, the engineer proceeds to the field. His instrumental equipment usually consists of hand level, steel tape, aneroid barometer, compass with sight alidade, and camera. In some investigations it is necessary to carry a current meter. These instruments and the notes, maps, and other data procured in advance, together with a map or de-

scription of the locations of the public land along the stream valley, constitute the working equipment. The engineer travels by wagon, on horseback with pack outfit, by boat, or on foot, as the conditions may require, and his personal equipment is made appropriate to the conditions.

The engineer, after examining all the lands in the stream valley and studying the relation of the critical features to the public lands, constructs what may be called a mental picture of the situation in its most productive condition of water-power development. He also works out the variations which might be made in his plan of development, knowing well that no other engineer covering the same ground independently would conceive the identical plan of development that he would. It is even necessary for the engineer to consider plans and possibilities that may appear to him impracticable or fantastic, for the serious proposal of such plans is a frequent occurrence in the routine experience of the department, and a relatively superficial glance over the country gives evidence that many such plans have been put into effect. Especially is it necessary for the engineer to gather local information concerning proposed developments of all kinds and to obtain as many working details of such developments as may be possible. To this end it is frequently essential to follow up rumors of prospective development. Although most of these rumors may prove inconsequential, they now and then lead to information whose importance fully compensates for the time spent on rumors that have no basis in fact.

If the engineer's investigations show that the slope of a river along a certain section affords a working head which, in connection with the known or supposed flow of the stream, indicates the possibility of a power site, he determines in a rough way the method or methods by which that site may be utilized. It is unnecessary for him to make final location surveys, because the fact that the power site exists is usually sufficient for the purposes at hand. The particular method of development will eventually be determined largely by the state of the science at the time the development is to be made. It is recognized that the details of location and equipment depend on the progress attained at the time of construction. We know, for example, of many old developments which if constructed to-day would be of an entirely different type.

The standards of capacity which warrant the withdrawal of public lands for power sites vary with the location, and in many cases the decision rests largely on the abundance of power sites in the immediate region. A stretch of river having a fall of 10 feet to the mile may, in regions where power sites are not abundant, be worthy of withdrawal, whereas a similar stretch in a region abundantly supplied with sites of greater capacity may not be of sufficient importance for departmental action. The determination of the proper course is difficult, for the question of feasibility must be partly answered with regard to future conditions. All the factors discussed in the beginning of this section, such as domestic water supply, irrigation, and transportation, must be borne in mind, and it is imperative that the engineer remember the fact that Government control of a small amount of land may be quite as effectual in the ultimate control of the development at the power site as if every element of that site were in public ownership. A small tract of land, even a fractional subdivision, located within a storage-reservoir site or along a diversion right of way has been sufficient to determine the control of the development. Having reached a decision on all the points above discussed, the engineer makes appropriate report.

Detailed surveys are not attempted in reconnaissance work. Approximate cross sections are taken at possible dam sites and, after the most feasible height of the dam is determined, a rough estimate of the area that would be submerged is made by means of the hand level. Where no profile of the stream channel is available, the fall over a short distance is determined with an aneroid barometer. This instrument, however, must be used with caution, especially during changeable weather. Photographs of all the critical points are taken. The possible dam sites suitable for storage or for diversion having been located and the type of development roughly determined, it is then necessary to consider the run-off. If the problem is one of storage, it will be sufficient to know the approximate mean annual run-off; the height of the storage dam can then be so fixed that the capacity of the reservoir may, as nearly as practicable, be sufficient to afford complete control. Of course, as a rule, sufficient storage capacity is not available, yet on the other hand there are situations in which the dam might be raised to a height that would give greater storage capacity than is necessary. In case no storage is to be provided, the mean daily flow of the stream must, if possible, be determined in order that the primary power capacity of the site may be appraised. If the available site is located in a canyon, it becomes necessary to determine within reasonable limits whether the maximum fall may be secured by a low diversion dam and conduits or whether it would be more economical to obtain the necessary height by the construction of a high dam.

Much of the land along the streams of the West has passed into private ownership, and where good facilities exist for the development of water power or the diversion of water for irrigation private interests may have established rights to the use of the water. Another complication on many streams consists in the location of railroad rights of way. Thus the problem of land classification may be

greatly complicated, and considerable thought and good judgment are required to determine on a plan whereby the stream may be utilized to a reasonable capacity and the vested rights already acquired by private owners may not be violated. Many of the power plants already installed use only a small percentage of the maximum available power. In such cases either the plans for ultimate maximum power development involve the utilization and enlargement or improvement of such plants or they are omitted from consideration, it being assumed that when the demand for power increases to a certain point ordinary commercial procedure will settle all questions relative to the destiny of power plants in operation.

In case a railroad is already constructed parallel to the stream, plans for immediate development must avoid any interference with the railroad rights. Few plans that would require relocation of railroads are feasible under present market conditions, but the future demand for power will probably change the aspect of the case, and on this account the problem is treated as if the railroad did not exist, it being assumed that whenever the demand for power is sufficient to justify the expense of railroad relocation the power will be developed. It is quite as desirable to provide means for future control by the Government in such an event as it is to provide such control in situations where no complications of this kind exist. Therefore, an important part of the field work consists in the determination of possible relocations, so that in fixing the value of any land reserved for a power site the department may have information whereby it can render an opinion as to the possibility and cost of relocating such lines as are already constructed or as to the feasibility of requiring the relocation of rights of way for which application may subsequently be made.

DETAILED FIELD INVESTIGATIONS.

Investigations of detailed character are made to obtain data for final departmental action. The statements in the preceding section indicate that the chief object of the reconnaissance work is to locate lands suitable for power sites. The capacity of the power sites is determined in connection with such work largely for the purpose of justifying the preliminary withdrawal of the lands from entry. Incidental information of a more or less final character is collected during the reconnaissance examination, for the most part with a view to convenience and economy in the final detailed surveys. The withdrawals of lands for power sites on the basis of a reconnaissance examination are usually made liberal in extent, the purpose being to restore to entry any of the legal subdivisions which on detailed survey prove to be of no value in connection with the plans finally

adopted. The detailed investigation consists of surveys to determine river profiles, surveys of reservoir site, soundings at dam sites and other places, and a more or less careful examination of the character of the underlying formations that must serve as foundations, especially for dams. In addition, it is necessary to establish river gaging stations, if none have already been established, for the purpose of determining, with a high degree of accuracy, the amount of water discharged by the river, so that the economic capacity of the reservoirs and power plants may be determined.

The gaging stations are selected, equipped, and maintained according to the standard methods followed by the United States Geological Survey in its regular hydrometric work. The processes are fully described in the annual progress reports on investigations of stream flow published by the Survey.

The investigation of dam sites for the purpose of determining the security of the underlying formations that must serve as foundations has, up to the present time, been based largely on general geologic information concerning the holding qualities of the formations known to exist in the localities examined. Final work of this character, none of which has been attempted in connection with the classification of water-power sites, will consist of the usual soundings and borings to determine the depth of the holding material, its permeability, its strength, and all the other factors that enter into its suitability for foundations.

Special river surveys delineating the alinement and water-surface contours of streams and the topography of the adjacent land are made on a scale of 2 inches to the mile by the plane-table and stadia method. The survey maps are accompanied by profiles showing clearly the stream gradient. The contour interval on water surfaces is usually taken as 5 feet but may be increased to 25 or even to 100 feet for sections of steep slope where the delineation of a lesser interval could not be clearly made. The topography of the land adjacent to the stream is shown by a contour interval of 25 feet and in general is carried to an elevation 100 feet above the stream by survey and an additional 100 feet by sketching. General features of culture, gaging stations, existing hydraulic works, all lines of land subdivisions by public survey, and other relevant data are shown on these maps. Promising reservoir and dam sites are shown with contour intervals of 5 feet to an elevation equal to the height of the possible dam.

Engineers executing these surveys are instructed to obtain and furnish to the Washington office all available data as to the water resources involved, supplementing the data shown on the maps by detailed description of existing or proposed developments.

COMPILATION OF RESULTS AND REVISION OF WITHDRAWALS.

When results of field investigation are available, much the same procedure is followed in the office in revising withdrawals as in making the preliminary withdrawals. The problem at this stage becomes one of limiting the withdrawals to the least possible area. Careful scrutiny of plans and profiles of the streams makes it possible to determine the power value of each smallest legal subdivision, and withdrawn areas containing no sites that are or may be valuable for the development of power are restored to the public domain. If the stream is of relatively flat gradient, where power development must be restricted to the low-head type and the construction will consist of power houses in conjunction with dams developing the available head, it is possible in many cases to locate definitely the favorable dam sites and divide the stream into successive units of probable development, from which no very great departure in construction is likely. On such streams the power-site reserves can be defined with a high degree of accuracy, and the use of each tract, whether for dam site, power-house site, flowage, or other purpose, can be forecast with considerable assurance. A minimum area of land is retained in power-site reserves on such streams. If the stream has a relatively steep gradient, however, where the natural development for power will consist of a low diversion dam and a long conduit leading to a power house perhaps several miles below and developing a high effective head, there can be a wide range of selection for the units of a comprehensive power project. On such a stream no specially favorable dam site is necessary, and relative expense of construction is generally the factor determining a choice among several different locations for the conduit. A definite use for any particular tract can seldom be assigned with development of this type, and the power-site reserve must be maintained so as to include all possible conduit locations if it is to be effective. A final revision of withdrawals along such a stream must be made as the power sites are developed. Even in such cases, however, restorations are frequently possible as soon as field examinations are made.

Restorations are recommended by the Survey and recorded in the Survey files in much the same way as withdrawals. The usual form of power-site restoration is as follows:

DEPARTMENT OF THE INTERIOR,
UNITED STATES GEOLOGICAL SURVEY,
Washington, November 18, 1913.

The honorable the SECRETARY OF THE INTERIOR.

SIR: Investigation of lands included in power-site reserve No. 117, Snake River, Idaho, indicates that the portion of the lands included therein described in the following order of restoration is not valuable for the conservation of

water power, and I therefore recommend that the said order of restoration be submitted to the President for appropriate action. The area involved in this restoration is 85.7 acres.

Very respectfully,

GEO. OTIS SMITH,
Director.

DECEMBER 3, 1913.

Respectfully referred to the President with favorable recommendation.

WALTER L. FISHER,
Secretary.

ORDER OF RESTORATION No. 82.

Snake River, Idaho.

So much of the orders of withdrawal made heretofore for the purpose of reserving water-power sites as affects the lands hereinafter described is hereby revoked.

And it is further ordered that all of such lands not otherwise reserved or withdrawn are hereby restored to the public domain and shall become subject to settlement and entry under the laws applicable thereto upon such date and after such notice as may be determined upon by the Secretary of the Interior.

Boise meridian.

T. 8 S., R. 4 E., sec. 30, lot 6;
sec. 32, lots 7 and 8.

WM. H. TAFT,
President.

DECEMBER 3, 1913.

ADVERSE CLAIMS.

In many cases there is a conflict between the purposes of a power-site reserve and of some other claim to or proposed use of the lands affected. There is at present no satisfactory law under which land withdrawn for power purposes under the acts of June 25, 1910 (36 Stat., 847), and August 24, 1912 (37 Stat., 497), can be used for other purposes without jeopardizing the interest of the United States in the power possibilities. Under the acts relating to rights of way title to land by legal subdivisions is not granted and, as described elsewhere (p. 28), the interest of the United States may be preserved. Under the laws relating to agricultural land and mining, however, title to the land embraced in entries or claims passes from the United States and there appears to be no way in which the power estate may be satisfactorily reserved. Relative priority of reserve and claim, special exceptions, and relative value are the principles that govern in adjudicating the conflict. A power-site withdrawal is of no effect as against bona fide metalliferous mineral claims, without regard to priority of initiation. A power-site withdrawal is without effect as against a prior occupant or claimant of oil or gas lands who is diligently prosecuting work leading to discovery, but it becomes immediately effective against such occupant or claimant if diligent

greatly complicated, and considerable thought and good judgment are required to determine on a plan whereby the stream may be utilized to a reasonable capacity and the vested rights already acquired by private owners may not be violated. Many of the power plants already installed use only a small percentage of the maximum available power. In such cases either the plans for ultimate maximum power development involve the utilization and enlargement or improvement of such plants or they are omitted from consideration, it being assumed that when the demand for power increases to a certain point ordinary commercial procedure will settle all questions relative to the destiny of power plants in operation.

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prosecution of work leading to discovery is discontinued. A power-site withdrawal is without effect as against a valid subsisting homestead or desert-land entry or claim of valid settlement so long as it is maintained and perfected pursuant to law, but the withdrawal becomes effective whenever the entryman or settler no longer continues to comply with the law under which the entry or settlement was made. With the foregoing exceptions, a power-site withdrawal under the acts of June 25, 1910, and August 24, 1912, is effective against all claims or entries on which rights have not vested prior to the date of the withdrawal.

Withdrawn lands having valuable possibilities for the development of power are alienated in the usual way if they are included in the excepted classes described above, although possibly the claims for such lands are subjected to a more careful scrutiny. If it appears that the claimant is attempting to obtain title to land because of its value for power, and if its power value is greater than its value for the alleged purpose of the claim, patent may be refused and the entry canceled. Cases of this nature arise most frequently in connection with metalliferous mineral entries, although not a few power sites have been homesteaded or acquired under the timber and stone law.

In the case of claims against which a power-site withdrawal is effective, a most unfortunate situation occasionally arises. For example, title to land may be sought by the application of scrip, and the claim may be initiated in advance of a power-site withdrawal. The claimant may have expended considerable sums in improvement and cultivation and have proceeded throughout in good faith. Nevertheless, the land sought to be acquired may be worth for power many times its agricultural value, and when this dominant power value is ascertained the land is naturally included in a power-site reserve. In such cases it is always a grave question whether the public interest is best served by the defeat or confirmation of the claim. Under the strict rule of the law the claimant has no rights in the case. No provision of law makes it possible to give him agricultural rights and reserve to the United States the rights of power development. Unless, therefore, the value of the land for the development of power is so great as to demand reservation for that purpose, public interest appears to sanction the claim of the individual as against that of the Nation, and elimination of the land from the power-site reserve is recommended.

NONPOWER CLASSIFICATION.

In connection with the office studies incident to the report on the power-site possibilities of lands embraced in subsisting claims and with the investigation of power sites a mass of information is gradually being accumulated. This information is of negative as well as of positive character and shows where power sites are not located as well as where they are located. For convenience in making later reports on adjacent areas, this information is summarized from time to time and State maps are prepared showing the lands that are of no value for power development. This essentially constitutes a negative power classification and the use of such maps greatly facilitates the future work. In connection with these maps minutes are prepared in which are set forth the data on which the classification is based and the conclusions drawn therefrom.

ADDITIONAL REQUIREMENTS TO MAKE POWER CLASSIFICATION EFFECTIVE.

In order that the classification of land as chiefly valuable for the development of power may be made effective, it appears desirable that there be additional legislation providing for the control and utilization of land so classified under such conditions and regulations as Congress may decide to be necessary and for the proper administration of such land if, as now seems desirable, the title is to be retained in the United States.

As a feature, or perhaps as a preliminary step in such legislation, a "separation act" would be desirable, providing for the disposition of power and agricultural estates independently of each other in a manner similar to that now provided for coal land and for oil and gas land in Utah. Such independent disposition of these estates is believed to be entirely feasible, because, except where reservoirs are provided, the land actually occupied by a power plant constitutes only a small part of the legal subdivisions on which the dam, flowage, water conduits, power house, and transmission lines are located. The bulk of the land is available for agricultural or other use and may be largely so utilized without detriment to the power development.

The alienation of the agricultural estate and the retention of the water-power estate in any land, with provision for payment of proper damages to the agricultural estate when the power is developed, appears to be practicable and desirable in the interest of the orderly development of the natural resources involved. In fact, a separation of estates and a disposition of each estate as such appear to be desirable, even though it may be decided not to retain control by the United States of the water-power estate.

Whether or not a law providing for separation of the power estate is enacted, laws providing for the development of power on public land under such conditions that the industry would be materially encouraged and capital attracted would be most beneficial. The true purpose of power-site withdrawals is the use of valuable power lands primarily for developing power, not the withholding of such lands

United States Department of the Interior

GEOLOGICAL SURVEY
WASHINGTON, D.C. 20242

JUN 18 1973

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Conservation Division
U.S. GEOLOGICAL SURVEY
Menlo Park, California

Memorandum

To: All Area and District Geologists

Through: Regional Conservation Managers, Central Region
Eastern Region
Western Region

From: Chief, Conservation Division

Subject: Resource-Reserve calculations - bedded leasable mineral deposits

This memorandum modifies my instructions of December 1, 1969, with respect to methods of calculation of in-place resources for coal in particular and other leasable minerals typically occurring in beds of considerable lateral continuity.

Our most pressing need at the present time with respect to such work by District and Area Geologists is to provide calculations of coal in-place ("identified coal resources" of USGS Prof. Paper 820) in measured, indicated and inferred categories for use by Area and District Mining Supervisors in calculating recoverable reserves for purposes of establishing bonuses for future competitive lease sales and advance accumulative royalties for leases to be issued or lease continuances. (See enclosed memorandum of April 27, 1973, to Area and District Mining Supervisors with respect to use of tonnage calculations).

Previous instructions on resource-reserve calculations, as outlined in my memorandum of December 1, 1969, apparently led to overemphasis upon adherence to the "Suggested Rules" and resultant restriction of geologic judgment. In addition, a previous draft instruction memorandum of August 30, 1972, with respect to "Establishment of Bonuses, Rentals, and Accumulative Advance Royalty determinations" led to unrealistic discounting of resources calculated using the "Suggested Rules". These matters were discussed at the Branch of Mineral Evaluation Conference in New Orleans in November 1972. The discrepancies were verified by Hinds and Czarnowsky when they attempted to provide data on lease Montana 069782 for our proposed Coal lease data system. The problem and proposed alternatives are outlined in the enclosed memorandum by Rioux of February 27, 1973.

In order to meet our responsibilities in providing resource-reserve information on bedded leasable minerals on Federal lands in a uniform manner for use in competitive leasing, lease data systems, and overal Federal mineral management programs, the following procedures will be followed:

(1) Classification of resources will follow usage employed in U.S.G.S. Prof. Paper 820 p. 1-8 (chart enclosed.)

(2) In-place or identified resources (reserves plus conditional resources) will be calculated by the appropriat District or Area Geologist.

(3) The identified resources will be calculated for measured, indicated and inferred categories and expressed as tons, or other appropriate units, and related to specific thickness, depth, and quality ranges for each bed in a given area outlined on a map or plat.

(4) The following definitions of measured, indicated, and inferred will be employed for these purposes:

(a) Measured identified resources:

Measured identified resources are those for which quantity is computed from dimensions revealed in outcrops, trenches, mine workings, and drill holes. The points of observation and measurement are so closely spaced and the thickness and extent are so well defined that the true quantity is judged to be not less than 80 percent of the computed quantity for the bed. Although the spacing of the points of observation necessary to demonstrate continuity varies in different regions according to the character of the beds, the points of observation are in general not greater than half a mile apart.

(b) Indicated identified resources:

Indicated identified resources are those for which quantity is computed partly from specific measurements and partly from projection of visible data for a reasonable distance on geologic evidence. In general, the points of observation are approximately one mile apart, but they may be as much as two miles apart for beds of known geologic continuity. Most important, geologic judgment should lead one to believe that the true quantity is judged to be not less than 50 percent of the computed quantity for the bed.

(c) Inferred identified resources:

Inferred identified resources are those for which quantitative estimates are based largely on broad knowledge of the geologic character of the bed or the region and for which few measurements of bed thickness are available. The estimates are based on an assumed continuity for which there is geologic evidence. In general, inferred identified resources are more than two miles from the outcrop or from points of mining or drill-hole information, for beds of known geologic continuity. Most important, geologic judgment should lead one to believe that the true quantity may be less than 50 percent of the computed quantity for the bed.

The area involved in calculations for the Measured, Indicated or Inferred reliability categories will be based upon distance from points of known information and geologic judgment. In general, 1/2 mile shall be used for projection of measured categories and as much as an additional 1-1/2 miles for indicated categories, but geologic judgment rather than these arbitrary guidelines should govern. For the inferred category, geologic judgment alone will govern. Prime reliance upon geologic judgment places emphasis upon that part of the reliability category definition that requires judgment as to the degree of certainty of the calculation. The degree of certainty, expressed as a percentage, will be the discount factor. The reliability category assigned will be based on the degree of certain which in turn is influenced by the distance from known points and geologic judgment. The three reliability categories for identified resources are thus summarized as follows:

	Range
Measured =	80 - 100%
Indicated =	50 - 79%
Inferred =	1 - 49%

(5) Following calculation of the total quantity in place, the geologist will apply a suitable discount factor to the calculated in-place identified resource for each reliabili category present. This discount factor will be multiplied by the calculated quantity and the totals will be reported to the appropriate Mining Supervisor as the in-place resource, as follows:

Category	Calculated Identified Resource	Selected Discount Factor	In-place Resource
Measured	1,000,000 tons	91%	910,000 tons
Indicated	2,000,000 tons	76%	1,520,000 tons
Inferred	8,000,000 tons	40%	3,200,000 tons
			5,630,000 tons

The total discounted in-place resource would thus be 5,630,000 tons.

(6) Area and District Geologists will provide Area and Distric Mining Supervisors with a map or plat indicating the area involved, thickness, quality and depth ranges as well as the calculated in-place tonnage (or other appropriate unit) for each bed, discounted for geologic certainty through use of these factors for each reliability category

(7) Area and District Mining Supervisors will calculate recoverable reserves by elimination of beds involving unworkable thickness, quality, or depth factors and will apply an appropriate recovery factor to workable beds. The difference between the identified, in-place resource calculated by the geologist and the reserves calculated by the mining engineer equal "conditional resources" of USGS Prof. Paper 820.

Note that this system provides:

(a) For full utilization of geologic judgment in calculating in-place resources.

(b) Identified resources would not be subjected to discounting other than by a factor for geologic certainty.

(c) All resource estimates (involving a combination of reserves plus conditional, hypothetical and speculative resources of Prof. Paper 820 p. 4), identified resources (reserves plus conditional resources), and potential resources (conditional, hypothetical and speculative resources) will be calculated by Area and District Geologists.

(d) All recoverable reserves will be calculated by Area and District Mining Engineers based on identified resources furnished by Area and District Geologists, with discounting only for workability factors reflecting current technology, safety, and economic factors and for recovery factors.

I trust these procedures will result in clarification of this important work and also provide uniform data for leasable mineral data systems. Any serious difficulties encountered in the application of these procedures should be reported promptly in order that we may further modify procedures if necessary.

Russell G. Wayland

Chief, Conservation Division

Enclosures

cc: ACD/RE
Area and Dist. Mining Supts (w/o enclosures)
ADC/Oper.
CBCMO
M. L. Millgate
J. A. MacKallor
RE file
CD file
RE chron.

RLRioux:RGWayland:
JAMacKallor:mfk 6-5=73

GEOLOGICAL SURVEY PROFESSIONAL PAPER 820
"UNITED STATES MINERAL RESOURCES"

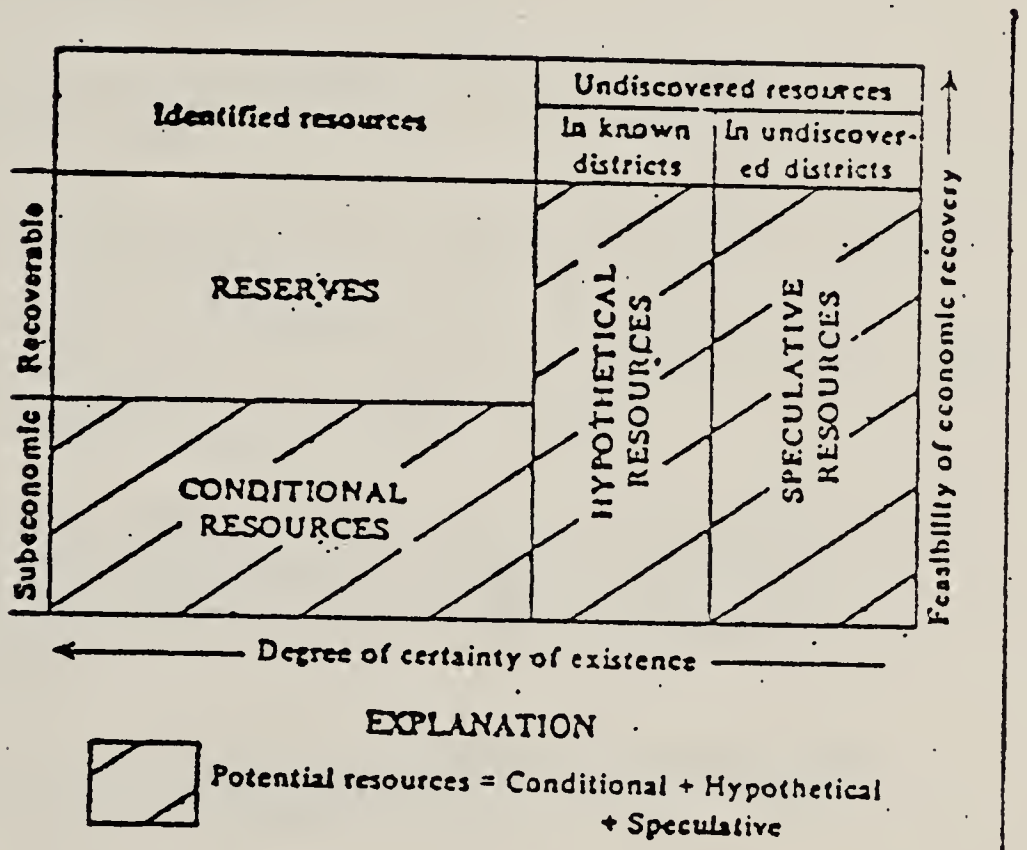


FIGURE 1.—Classification of mineral resources used in this volume.

United States Department of the Interior

GEOLOGICAL SURVEY
RESTON, VIRGINIA 22092

MAR 24 1975

Memorandum

To: All Area Geologists

Through: Conservation Managers, Central Region
Eastern Region
Western Region

From: Chief, Conservation Division

Subject: Mineral classification-evaluation priorities and specific coal priorities

In order to meet BLM needs under the EMARS system and discharge our responsibilities under S.O. 2948, we must systematically plan and schedule programs to meet our established goals. Our goals for classification and evaluation of leasable mineral solids must include the following programs to provide for GS input to BLM:

1. Identification of leasable mineral resource potential of Federal lands for retention-disposal and multiple use classification (1:250,000 leasable mineral and water classification maps).

2. Identification of lands subject to competitive leasing (establishment of known leasing areas).

3. Provision of detailed information as to leasable mineral occurrence within known leasing areas (leasable mineral resource occurrence maps).

4. Identification of the relative development potential of areas within known leasing areas (leasable mineral resource development potential overlays).

5. Identification of specific tracts for inclusion within lease sales (tract selection).

6. Calculation of potentially recoverable reserves and estimates of bonus values for sale tracts (tract evaluation).

Ideally, these goals will be met sequentially, in the order that they are listed. All ongoing projects not involved in meeting these objectives be reviewed RE people be instructed & trained to meet these requirements, all future field projects be reviewed towards these priorities.

A brief survey of these six goals follows:

1. 1:250,000 classification maps

We are required to furnish copies of 1:250,000 leasable mineral and water classification maps covering known leasing areas (KLA's) (as well as two-degree sheets showing geology and land-use if available from Geologic Division and LUDA) to BLM for multiple-use planning. In order for these 1:250,000 maps to be reliable for their purposes, Area Geologists must ensure that all classifications are now reviewed and updated, and that all prospectively valuable maps are updated on a continuing basis. Conservation Managers are responsible for ensuring reasonable rates of progress on these programs in their Region. Map format, standardization and reporting, as well as updating of mineral classification standards, should be coordinated by the Branch of Mineral and Water Classification.

2. Establishment of known leasing areas

Plats, and minutes with any proprietary information identified as such, should be provided to BLM for each KLA. Our priorities, if we are to meet the many demands placed upon us, must center around the definition of known leasing areas, to be followed by provision for accomplishing goals 3-6 within the known leasing areas.

Priorities among known leasing areas for pursuit of goals 3-6 should be based upon BLM priorities. Where we might differ with BLM on the sense of priorities, these matters should be discussed with BLM in an attempt to alter the priority lists - otherwise BLM priorities should be accepted.

Progress, to date, on this goal, has been less than satisfactory. Please review our plan to expedite this important work as outlined in my memorandum of June 25, 1973 (enclosed). Area Geologists should implement this plan immediately. Conservation Managers should ensure that reasonable progress is obtained. The Branch of Onshore Evaluation should provide for uniformity of procedures reporting and development of evaluation standards in conjunction with the Branch of Mining Operations.

3. Leasable mineral resource occurrence maps

Using the best topographic base available (1:62,500 or 1:24,000), all resource information concerning the leasable mineral involved in the KLA will be plotted for federally-owned mineral rights.

The land status to be shown on the map should be as taken from the BLM color quad. The data will include not only outcrops and quality and thickness measurements but location of boreholes and projected subsurface extent. A brief narrative to accompany this Resource Occurrence Map will provide details as to the quality, thickness, depth and extent of the resource and other pertinent information. These maps which are to be furnished to BLM could also be published with allowance for deletion of any proprietary information. Format, standardization and reporting should be coordinated by the Branches of Mineral and Water Classification and Onshore Evaluation.

4. Leasable mineral resource development potential overlays

An overlay to the Resource Occurrence Map will be provided which outlines 1) strippable, 2) deep mining, and 3) in situ sites classified as to development potential as: a) high, b) moderate, c) low, and d) insufficient data. The areas outlined on these Resource Development Overlays will be numbered and keyed to a brief narrative which will outline the resource availability, technological feasibility and economic factors influencing the judgments as to development potential. Area Geologists must coordinate their efforts with the appropriate Area Mining Supervisor in the preparation of these overlays which will be furnished to BLM. The Branch of Onshore Evaluation should provide for uniformity of procedures, reporting and format in conjunction with the Branch of Mining Operations.

5. Tract selection (in conjunction with the BLM District Manager)
6. Tract evaluation

Our role in onshore tract selection and pre- and post-sale evaluations awaits completion of tract selection and tract evaluation agreements with BLM. In the meantime, we are attempting to establish a number of DCF analysis task forces in the Regions for each of the leasable minerals that may be involved so that we will be prepared to implement joint agreements. The Assistant Division Chief-Resource Evaluation should coordinate efforts with BLM to reach both agreements.

We must continue similar work related to classification and particularly evaluation of mineral fluids (KGS-KGRA's), clear-listing of lease applications, mineral reports to land-managing agencies and work related to or in direct support of lease management. Where Area Geologists also have functions on Outer Continental Shelf lands, they must also, of course, receive high priority.

In order to meet these many priorities, I must request that:

1. All ongoing projects not specifically involved in the above priorities be deferred as expeditiously as possible.

2. Resource evaluation personnel be instructed and trained, as appropriate, to meet these requirements.

3. All future field projects be specifically oriented toward one or more of the six priorities itemized above.

Realizing this adds or shifts considerable workload, it will be necessary to

1. Defer systematic formal mineral land classification field work outside known leasing areas at this time. Case-by-case classifications using prospectively valuable classification standards and available data suffice for retention of mineral rights and multiple-use planning purposes.

2. Restrict future mapping projects to establishment or "break-down" of KLA's, or to spot investigations related to one or more of the six priorities listed.

3. Identify other mapping needs for reference to Geologic Division for accomplishment (formal classification "wipe-out-the-withdrawals," etc.)

4. Have BLM obtain time-consuming advisory services for locatable and common variety minerals from Geologic Division.

5. Restrict Area Geologists' work on Indian lands to aid to lease management, with all systematic resource appraisals of large areas to be done by Geologic Division.

BLM has furnished us with a listing of their first priority need for Coal Occurrence Maps (goal 3) in support of their proposed Federal coal leasing program for seven states, all in the Central Region. Priorities are given in terms of "color quad" numbers except Oklahoma where 7-1/2 minute quadrangles are used. While all quadrangles listed are designated as first priority, the highest priority in a State is listed first.

United States Department of the Interior

GEOLOGICAL SURVEY

Reston, Virginia 22092

RECEIVED
JUN 2 1976
MAY 26 1976
Conservation Division
U.S. GEOLOGICAL SURVEY
Office of the Area Geologist
Menlo Park, California

Memorandum

To: Conservation Managers
Area Geologists

From: Chief, Conservation Division

Subject: Reserves and resources terminology - mineral land classification for retention

The standards that we have used for classifying coal, phosphate, potash, sodium, and other mineral lands for retention of the leasable minerals do not agree in all their terms with the standards for determining reserves and resources adopted recently by the Geological Survey and the Bureau of Mines. Bulletins 1450-A and 1450-B of the Geological Survey cover the new standards for reserves and resources.

Conservation Division, in continuing its work in classifying the public lands for the leasable minerals for retention or multiple-use purposes, is not bound to use all provisions in the standards of Bulletins 1450-A and B. However, henceforth when we do not use those standards in every respect, we should make that clear in our reports and be prepared to explain why we have not followed the standards. One reason will be that the retention standards that we have used have always been those approved by the Directors for the specific purposes of designating lands for retention of leasable minerals. The primary purpose has been to protect resources and reserves, not to measure them.

Until further notice, specific examples of significant conflict between our standards for classification of mineral lands and the current standards adopted by Survey/Mines should be called to the attention of this office so that appropriate consideration of revisions or defense of old standards can be achieved.

Separate instructions are being issued as to the use of the Survey/Mines definitions with regard to mineral leasing evaluations (KCLA's, pre-sale values, advance cumulative royalties, etc.).

Chief, Conservation Division

cc: ADC-RE
B/M & WC
ESP Section
OSP Section

AMERICAN REVOLUTION BICENTENNIAL 1776-1976

Principles of the Mineral Resource Classification System of the U.S. Bureau of Mines and U.S. Geological Survey

MINERAL RESOURCE CLASSIFICATION SYSTEMS OF THE U.S. BUREAU OF MINES AND U.S. GEOLOGICAL SURVEY

GEOLOGICAL SURVEY BULLETIN 1450–A

A report published jointly by the
U.S. Bureau of Mines and
U.S. Geological Survey

Definitions of mineral resource classification terms used by the U.S. Bureau of Mines and U.S. Geological Survey

UNITED STATES GOVERNMENT PRINTING OFFICE, WASHINGTON : 1976

UNITED STATES DEPARTMENT OF THE INTERIOR

THOMAS S. KLEPPE, *Secretary*

GEOLOGICAL SURVEY

V. E. McKelvey, *Director*

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FOREWORD

In order to use mineral resource terms with precision and common understanding and to compare resource data effectively, a joint U.S. Bureau of Mines and U.S. Geological Survey work group developed a standardized, definitive, broadly applicable classification system to derive uniform, coordinated resource estimates. This report presents the results of the work group that developed the basic terms of mineral resource classification. Other chapters in this series will present classification terms for specific commodities.



Thomas V. Falkie
Director, Bureau of Mines

V. E. McKelvey
Director, Geological Survey

CONTENTS

	Page
Foreword	III
General definition of mineral and energy resources	A1
Philosophic basis for a resource classification	1
Glossary of resource terms	2
Areas of responsibility and operational procedures	4

ILLUSTRATION

	Page
FIGURE 1. Classification of mineral resources	A2

PRINCIPLES OF THE MINERAL RESOURCES CLASSIFICATION SYSTEM OF THE U.S. BUREAU OF MINES AND U.S. GEOLOGICAL SURVEY

GENERAL DEFINITION OF MINERAL AND ENERGY RESOURCES

The dictionary definition of resource "something in reserve or ready if needed" has been extended for mineral and energy resources to comprise all materials surmised to exist having present or future values. In geologic terms a mineral or energy resource is a concentration of naturally occurring solid, liquid, or gaseous materials in or on the Earth's crust in such form that economic extraction of a commodity is currently or potentially feasible. Material classified as a reserve is that portion of an identified resource producible at a profit at the time of classification.

Total Resources are materials that have present or future value and comprise identified or known materials plus those not yet identified, but which on the basis of geologic evidence are presumed to exist.

PHILOSOPHIC BASIS FOR A RESOURCE CLASSIFICATION

Public attention usually is focused on current economic availability of mineral or energy materials (reserves). Long-term public and commercial planning, however, must be based on the probability of geologic identification of resources in as yet undiscovered deposits and of technologic development of economic extraction processes for presently unworkable deposits. Thus, all the components of Total Resources must be continuously reassessed in the light of new geologic knowledge, of progress in science, and of shifts in economic and political conditions.

Another requirement of long-term planning is the weighing of total or multi-commodity resource availability against a particular need. To achieve this the general classification system must be uniformly applicable to all commodities so that data for alternate or substitute commodities can be compared.

To serve these planning purposes Total Resoures are classifi both in terms of economic feasibility and of the degree of geolog assurance. The factors involved are incorporated in figure 1 provide a graphic classification of Total Resources.

General guides for the use of this classification system are follows:

1. Resource categories and definitions in the classification, specified in the glossary, should be applicable to all naturally o curring concentrations of metals, nonmetals, and fossil fuels. T categories may be subdivided for special purposes.

2. Definitions may be amplified, where necessary, to make the more precise and conformable with accepted usage for particul commodities or types of resource evaluations.

3. Quantities and qualities may be expressed in a variety terms and units to suit different purposes, but must be clear stated and defined.

GLOSSARY OF RESOURCE TERMS

Resource.—A concentration of naturally occurring solid, liqui or gaseous materials in or on the Earth's crust in such for

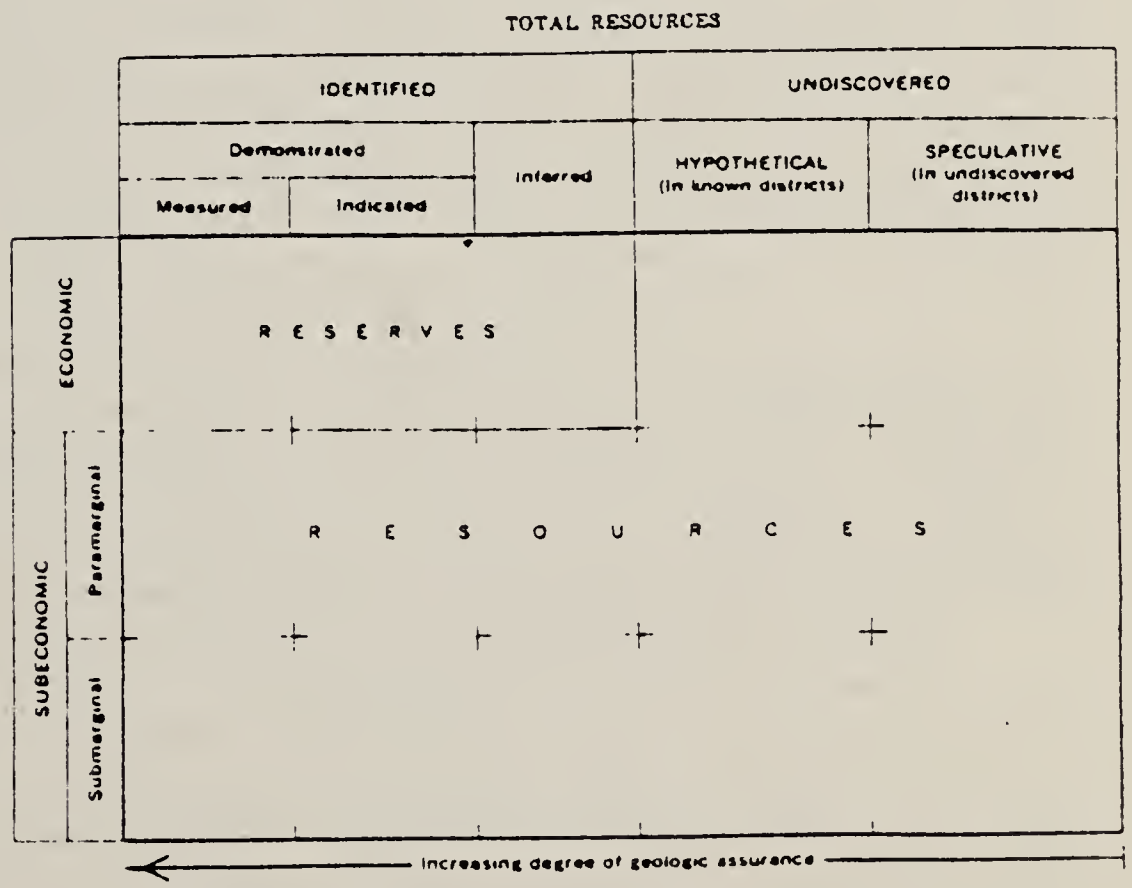


FIGURE 1.—Classification of mineral resources.

that economic extraction of a commodity is currently or potentially feasible.

Identified resources.—Specific bodies of mineral-bearing material whose location, quality, and quantity are known from geologic evidence supported by engineering measurements with respect to the demonstrated category.

Undiscovered resources.—Unspecified bodies of mineral-bearing material surmised to exist on the basis of broad geologic knowledge and theory.

Reserve.—That portion of the identified resource from which a usable mineral and energy commodity can be economically and legally extracted at the time of determination. The term *ore* is used for reserves of some minerals.

The following definitions for measured, indicated, and inferred are applicable to both the Reserve and Identified-Subeconomic resource components.[1]

Measured.—Reserves or resources for which tonnage is computed from dimensions revealed in outcrops, trenches, workings, and drill holes and for which the grade is computed from the results of detailed sampling. The sites for inspection, sampling, and measurement are spaced so closely and the geologic character is so well defined that size, shape, and mineral content are well established. The computed tonnage and grade are judged to be accurate within limits which are stated, and no such limit is judged to be different from the computed tonnage or grade by more than 20 percent.

Indicated.—Reserves or resources for which tonnage and grade are computed partly from specific measurements, samples, or production data and partly from projection for a reasonable distance on geologic evidence. The sites available for inspection, measurement, and sampling are too widely or otherwise inappropriately spaced to permit the mineral bodies to be outlined completely or the grade established throughout.

Demonstrated.—A collective term for the sum of measured and indicated reserves or resources.

Inferred.—Reserves or resources for which quantitative estimates are based largely on broad knowledge of the geologic charac-

[1] The terms proved, probable, and possible (used by the industry and economic evaluations of ore in specific deposits or districts) commonly have been used loosely and interchangeably with the terms measured, indicated, or inferred (used by the Department of the Interior mainly for regional or national estimates). The terms "proved" and "measured" are essentially synonymous. The terms "probable" and "possible," however, are not synonymous with "indicated" and "inferred." "Probable" and "possible" describe estimates of partly sampled deposits—in some definitions, for example, "probable" is used to describe deposits sampled on two or three sides, and "possible" for deposits sampled only on one side; in the Bureau-Survey definitions, both would be described by the term "indicated."

ter of the deposit and for which there are few, if any, samples or measurements. The estimates are based on an assumed continuity or repetition, of which there is geologic evidence; this evidence may include comparison with deposits of similar type. Bodies that are completely concealed may be included if there is specific geologic evidence of their presence. Estimates of inferred reserves or resources should include a statement of the specific limits within which the inferred material may lie.

Identified-Subeconomic.—Resources that are not Reserves, but may become so as a result of changes in economic and legal conditions.

Paramarginal.—The portion of Subeconomic Resources that (1) borders on being economically producible or (2) is not commercially available solely because of legal or political circumstances.

Submarginal.—The portion of Subeconomic Resources which would require a substantially higher price (more than 1.5 times the price at the time of determination) or a major cost-reducing advance in technology.

Hypothetical resources.—Undiscovered resources that may reasonably be expected to exist in a known mining district under known geologic conditions. Exploration that confirms their existence and reveals quantity and quality will permit their reclassification as a Reserve or Identified-Subeconomic resource.

Speculative resources.—Undisovered resources that may occur either in known types of deposits in a favorable geologic setting where no discoveries have been made, or in as yet unknown types of deposits that remain to be recognized. Exploration that confirms their existence and reveals quantity and quality will permit their reclassification as Reserves or Identified-Subeconomic resources.

AREAS OF RESPONSIBILITY AND OPERATIONAL PROCEDURES

U.S. Bureau of Mines.—The Bureau appraises, analyzes, and publishes reserve estimates from base data supplied by the mineral and energy materials industry, the U.S. Geological Survey, and other governmental agencies. The Bureau judges commodity recoverability on existing economic and legal factors.

U.S. Geological Survey.—The Survey appraises, analyzes, and publishes estimates of Total Resources. It reports such measurable parameters of significance to resource evaluation as location, quality, quantity, and situation of Identified resources.

Annual Resource Summation.—The U.S. Bureau of Mines and U.S. Geological Survey will confer and agree annually on estimates in all of the resource categories defined above. These data will be in Bureau or Survey publications and will be available for inclusion in the Secretary's Annual Report required by the Mining and Minerals Policy Act of 1970.

Ad Hoc Joint Conferences.—The Directors will convene ad hoc joint work groups to resolve problems in the resource area.

UNITED STATES
DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY
Conservation Division
Area Geologist's Office
345 Middlefield Road
Menlo Park, California 94025

March 10, 1978

Memorandum

To: File

From: Supervisory Geologist, Non-Energy Minerals Section

Subject: Prospectively Valuable - Terminology

In order to eliminate some of the confusion and frustration of the "Prospectively Valuable" vs. "Valuable Prospectively" terminology, I called Larry Godwin, the new Branch Chief for Mineral and Water Power Classification, and was told and I quote, "the correct terminology is prospectively valuable".

According to Mr. Godwin, the terminology has changed from the original "Prospectively Valuable" to "Valuable Prospectively" and now back to "Prospectively Valuable". Unfortunately, the term was wrongly used in the recent United States v. Bardsley case and also in a recent memo signed by Mr. Godwin. Nevertheless, the proper term is "Prospectively Valuable". Mr. Godwin was going to contact our office again to inform the writer whether an instruction memo from Mr. Baterman exists on this topic.

Peter Oberlindacher

cc: Conservation Manager, Western Region

United States Department of the Interior

GEOLOGICAL SURVEY
6041 Federal Building
1961 Stout St. -- Drawer 3586
Denver, Colorado 80202

Memorandum

June 10, 1975

To: Assistant Division Chief, Resource Evaluation

From: Chief, Branch of Mineral & Water Classification

Subject: Mineral Land Classification

Submitted herewith is a proposed memorandum for signature by the Chief, Conservation Division on mineral land classification with instructions for valuable prospectively determinations and for formal classification.

Andrew F. Bateman, Jr.
Chief, Branch of Mineral & Water Classification

Enclosure

Proposed

Received from Bateman 10/7
(not approved by Wash. D.C.)

United States Department of the Interior

GEOLOGICAL SURVEY
RESTON, VIRGINIA 22092

Memorandum

To: Regional Conservation Managers, Central Region
Eastern Region
Western Region

Area Geologists (Onshore)
District Geologists (Onshore)

From: Chief, Conservation Division

Subject: Mineral Land Classification

Relationship to Conservation Division Responsibilities

Geologic work in the Conservation Division can be divided into four comprehensive categories:

1. Accumulation of basic geologic data
2. Mineral land classification
3. Mineral land evaluation
4. Lease management support

Most of the field work and much of the other work of the field offices is directed toward the collection of basic geologic data which, in effect, is an inventory of the leasable mineral resources in public, acquired and Indian lands. Basic geologic data include but are not limited to:

1. Compilation of existing data from:

   a. Published literature, theses, and unpublished reports.
   b. Files of area and district geologists, area mining supervisors, and other USGS offices.
   c. State agencies and industry.
   d. Lithologic and electric logs of tests for oil and gas, water wells and seismic shot holes.

2. Geologic mapping by quadrangle or by strip maps and geologic examination of specific tracts.

3. Drilling and electric logging to supplement mapping.

4. Collection of samples from outcrops and formations bearing leasable minerals drilled by tests for oil and gas. (In most wells, beds containing coal and some of the other leasable minerals are at rather shallow depth, and are

AMERICAN REVOLUTION BICENTENNIAL 1776-1976

penetrated before surface casing is set.) Hence, Geological Survey personnel must be on the rig at the time these beds are drilled, make their own depth measurements and grab their own samples.

5. Collection and preparation of samples for analyses to determine grade and purity of the material.

From these data can be prepared the following:

1. Geologic maps and sketches and cross sections.
2. Isopach maps of beds of leasable material.
3. Structure contour maps.
4. Overburden maps.
5. Tables showing chemical composition and quality of each leasable material.
6. Quantity estimates of the resources of each leasable material.
7. Township reports.
8. Reports for publication.

The work of mineral land classification, mineral land evaluation, and lease management support can be undertaken only after at least some of these basic data have been acquired.

Development

The classification activities of the Conservation Division are derived from the organic act creating the Geological Survey (March 3, 1879, 20 Stat. 377-394) which charged the Director with "the classification of the public lands, and examination of the geological structure, mineral resources, and products of the national domain." Subsequent statutes have modified or extended the classification function.

In the early days of this century, the need to insure appropriate disposition of the Federal lands and to secure the highest use of the Federal estate greatly increased scientific mineral land classification by the United States Geological Survey and made it an integral part of the administration of the Federal lands.

Definition and Purpose

Mineral land classification is the delineation of those lands that contain or may contain deposits of the leasable minerals, whether or

not they are capable of being exploited under today's economic conditions. The essential consideration is that all lands be included that are valuable for prospecting or that contain leasable minerals that at some time in the future may prove to be of economic value. Hence, classification is directed toward defining our potential leasable mineral resource lands and furnishing land managing agencies with geologic information useful in: (1) planning for future use of the leasable minerals; (2) determining alternatives in multiple use of the Federal lands; (3) retaining valuable mineral rights in disposal actions, and (4) inventorying our resource potential.

The classification of a tract of land as mineral or nonmineral is based on the geology of the area and the intrinsic value of the deposit with respect to quality, thickness and depth. Hence, the purpose of classifying the Federal lands is to define the areal and depth limits of each of the leasable minerals so as to make a scientific estimate of the amount and quality of the resource that is available.

The first step in the classification procedure is the withdrawal of lands containing leasable mineral from entry, exchange or sale under the Withdrawal Act of 1910. Next, classification standards are established for each leasable mineral. Since only the ultimate use of the material is important, these standards set minimum limits on the intrinsic factors of thickness, quality and areal extent and maximum limits on depth.

Classification Actions

Classification actions may be formal or informal.

Informal Classification

The principal informal classification action is the delineation of lands valuable prospectively for the various leasable minerals. This classification is used to cover areas where geologic information is not sufficient for formal classification. Lands valuable prospectively for a leasable mineral are defined as those lands for which presently available geologic information suggests that the leasable mineral in question may be present in sufficient quantity and of such quality as to meet current classification standards. This definition applies very well to bedded deposits of solid substances such as coal or phosphate, but is not so suitable for fluids such as oil and gas or for geothermal resources. The following definition was furnished the Committee on Interior and Insular Affairs by a letter dated June 20, 1967:

according to Bill Gere a valuable prospe
classification is the equivalent of
earlier withdrawal action

The term valuable prospectively for oil and gas is used by the U.S. Geological Survey relative to areas where geologic conditions offer some possibility for the occurrence of oil and gas but their presence has not been established. In classifying the lands as valuable prospectively, it is recognized that the degree of value may vary from near zero to near certainty depending on such factors as the nature of the rocks, extent of dissection by erosion, and proximity to production or previously drilled exploratory wells. From this, it is evident that the petroleum province is an established concept in classification of oil and gas lands for purposes of retention of Federal mineral rights upon disposal of public lands.

At the present time the following criteria are used in delineating lands valuable prospectively for oil and gas:

1. A section of sedimentary rocks either marine or nonmarine 1,000 feet or more in thickness.

2. The sedimentary strata have not been metamorphosed to the extent that any oil or gas has been driven off.

3. The sediments have not been intruded by igneous rocks to the extent that there are no prospects for oil and gas.

4. The fact that the rocks may now be under a thick cover of lava, alluvium, lacustrine deposits, glacial debris or other type of deposit does not eliminate them.

According to U.S. Geological Survey Circular 647, a geothermal resources province (GRP) similar in concept to a petroleum province is necessary to define those areas valuable prospectively for geothermal steam and associated geothermal resources. A geothermal resources province is an area in which higher than normal temperatures of the waters are likely to occur with depth and there is a reasonable possibility of finding reservoir rocks that will yield steam or heated fluids to wells. In most prospective areas, data on geothermal gradients and conductive heat flow are scarce. Adequate temperature-depth data exist only in sedimentary basins that have been extensively explored for oil and gas. Most of these basins are characterized by nearly "normal" geothermal gradients rather than the abnormally high rates needed for development of geothermal energy.

Current Status

Many of the determinations of lands valuable prospectively for a leasable mineral now in effect were made in haste under considerable pressure.

Quite often the state geologic map was used as a basis and the state base map on a scale of 1:500,000 was used as a base. These maps are no longer adequate.

Instructions for Revision

All current determinations of lands valuable prospectively for a leasable mineral should be reviewed and considered for revision. First priority should be given to lands inside known leasing areas, making certain that all are withdrawn, classified or valuable prospectively for the leasable mineral under consideration. Procedures for the revision or establishment of lands valuable prospectively for a leasable mineral are:

1. Make a study of published geologic literature, field data and other data in the files of the various Conservation Division offices or data available from other divisions of the Geological Survey, state agencies and industry.

2. Outline the areas involved in original determinations and revision on the 1:250,000 map scale. A base map showing the land net, drainage, roads, etc. for any area desired can be obtained from the Chief, Branch of Mineral & Water Classification.

3. Prepare a memorandum in the format of Exhibit 1 to the Area Geologist, who will appoint a reviewer. After review the Area Geologist will give final approval. Copies will be submitted to the Regional Manager, Chief, Conservation Division and Chief, Branch of Mineral and Water Classification. The latter will monitor the determinations for conformity to Divisio policy and for consistency from one area to another.

Formal Classification

At the present time, emphasis of field work is on obtaining basic data needed for the establishment of known leasing areas, especially coal. However, these data should include sufficient information for the classification of the lands involved. Only lands that have been classified mineral should be placed in a known leasing area.

In our haste to establish known coal leasing areas during the past two years, lands withdrawn for coal, lands classified noncoal and lands not valuable prospectively for coal have been included. Highest priority should be given to a review of all extant known leasing areas and the classification or reclassification of any such lands.

Instructions

As basic geologic data become available on specific areas, a review should be made to determine which lands contain one or more leasable mineral commodities in sufficient quantity and quality to meet classification standards for that commodity. Preferably this review should be conducted by the geologist or geologists who did the field mapping and collected other basic data. Classification shall be made by quarter-quarter section, surveyed tract or lot. A township classification plot, Exhibits 2 and 3, and minutes of the Mineral Land Classification Committee in the format of Exhibit 4 are prepared. Since minutes are open for public inspection, no direct reference to proprietary information should be made.

Paragraphs 3 and 4 should very briefly summarize the more complete information in the township report. Paragraphs 6 through N also should be brief and should emphasize the factors that determine which sections and subdivisions should be classified mineral or nonmineral. Since the Area Geologist is responsible, he should examine the minutes carefully before he signs as Chairman of the Committee. He submits the minutes together with the appropriate classification plats to the Regional Manager who appoints a geologist to review the minutes and plats and, when satisfactory, submits them to the Chief, Conservation Division through the Chief, Branch of Mineral and Water Classification, who monitors them for uniformity, prepares a mineral land classification order and memorand for the Director's signature transmitting copies of the order to the Federal Register and to the Bureau of Land Management.

Records

The Chief, Branch of Mineral and Water Classification will maintain a system of records and maps showing the status of withdrawn, classified and valuable prospectively lands. It will be his responsibility to inform the Regional Managers and Area Geologists of any discrepancies along state or regional boundaries and of any conflicts with Division policy.

Chief, Conservation Division

Enclosures (4)
Exhibit 1
Exhibit 2
Exhibit 3
Exhibit 4

cc: Asst. Division Chief, R/E
Evaluation Standards & Publications Sec.
Chief, Branch of Min. & Wtr. Classif.

Revised Format for
Prospectively Valuable Minutes

_____
(Date)

Memorandum

To: Area Geologist

From: _____

Subject: Revision of the boundary of lands in _____ (State)
valuable prospectively for _____ (commodity)

1. Introduction

   a. Date of establishment of limits of lands valuable prospectively

   b. Revisions with dates.

   c. ~~Qualifying statements.~~ classification guidelines used

2. Supporting Data

   a. General

      (1) Field work and office compilations.
      (2) Geologic considerations.
      (3) Estimated resources (when available).

   } Brief

   b. _____ (Mineral)-bearing rocks.

   c. Physical data on _____ (mineral) deposits.

3. Selected References.

EXHIBIT 1

4. Classification Action

The following described lands embracing _____ acres are classified as valuable prospectively (or not valuable prospectively) for _____ effective _____.
(mineral) (date)

T. ___ _., R. ___ _., P.M., _____
(State)

sec. 1, etc.

_____
(Geologist preparing the memorandum)

_____
District ~~or Area~~ Geologist

Reviewed by: _____; Date _____

Approved by: _____; Date _____
Area Geologist

Encl.: Map

cc: District Geologist
Area Geologist
Regional Manager
Chief, Conservation Division
Chief, Branch of Mineral & Water Classification

_____ _____
(State) (Commodity)

Minutes of the Mineral Land Classification Committee

Date: _____

Subject: _____ classification of lands in _____,
(Commodity) (Name of field or area)
Tps._____, Rs._____, _____, _____ County,
_____. (Meridian)
(State)

Minutes prepared by: _____
(Include geologist(s) and mining engineer(s) participating in preparation)

In consultation: _____

_____

(Outline)

1. Introduction

   a. Area involved, location and accessibility.
   b. Mineral land withdrawal numbers and approval dates. (If any land is withdrawn).
   c. Classifications and restorations, with dates.

2. Bases for committee action

   a. Field mapping and field investigations.
   b. Geologic maps and cross sections.
   c. Commodity sections.
   d. Other published reports and maps.

3. Physiography

   a. Physiographic province.
   b. Relief.
   c. Drainage.

4. General Geology

   a. Regional geologic setting.
   b. Stratigraphy.
   c. Structure.
   d. Geologic details that might affect mining of the commodity.

(State) (Commodity)

5. The Commodity

a. Distribution. This includes the number of beds, lateral continuity, areal extent, thickness and variations in thickness of each bed.
b. Partings and impurities such as pyrite in coal.
c. Physical and chemical properties. For coal give heating value in Btu per pound and kilogram-calories on an as received basis and ash and sulfur content in percent. For phosphate, potassium, sodium and sulfur, give percent. For oil shale, give gallons per ton and liters per metric ton.

6 through N. Description and classification by individual township.

a. Cite the withdrawal affecting the lands.
b. Briefly summarize the physiography and geology of the township, and discuss the stratigraphy pertinent to the mineral occurrence.
c. Give a detailed description of each bed containing the leasable mineral to be classified and discuss its lateral and vertical variations within the township.
d. On the basis of the above discussion, the following subdivisions embracing _____ acres are classified as _____ (commodity) lands.

T. ___ _., R. ___ _., _____ P. M., _____ (State)

sec. 1., etc.

e. The following subdivisions embracing _____ acres are reclassified as _____ (commodity) land.

T. ___ _., R. ___ _., _____ P. M., _____ (State)

sec. 1., etc.

f. The following subdivisions embracing _____ acres are classified (or reclassified) non_____ (commodity) land.

T. ___ _., R. ___ _., _____ P. M., _____ (State)

sec. 1, etc.

g. Restoration of the entire (or part) township is recommended by the Committee.

Submitted and recommended by the Committee:

_____
Geologist (who prepared minutes) Member

_____
Geologist Member

_____
Area Geologist Chairman

Reviewed by: _____; Date_____
(Geologist appointed by Regional Manager)

Approved by: _____; Date_____
Chief, Conservation Division

Enclosures: Classification Plat
Geologic Map

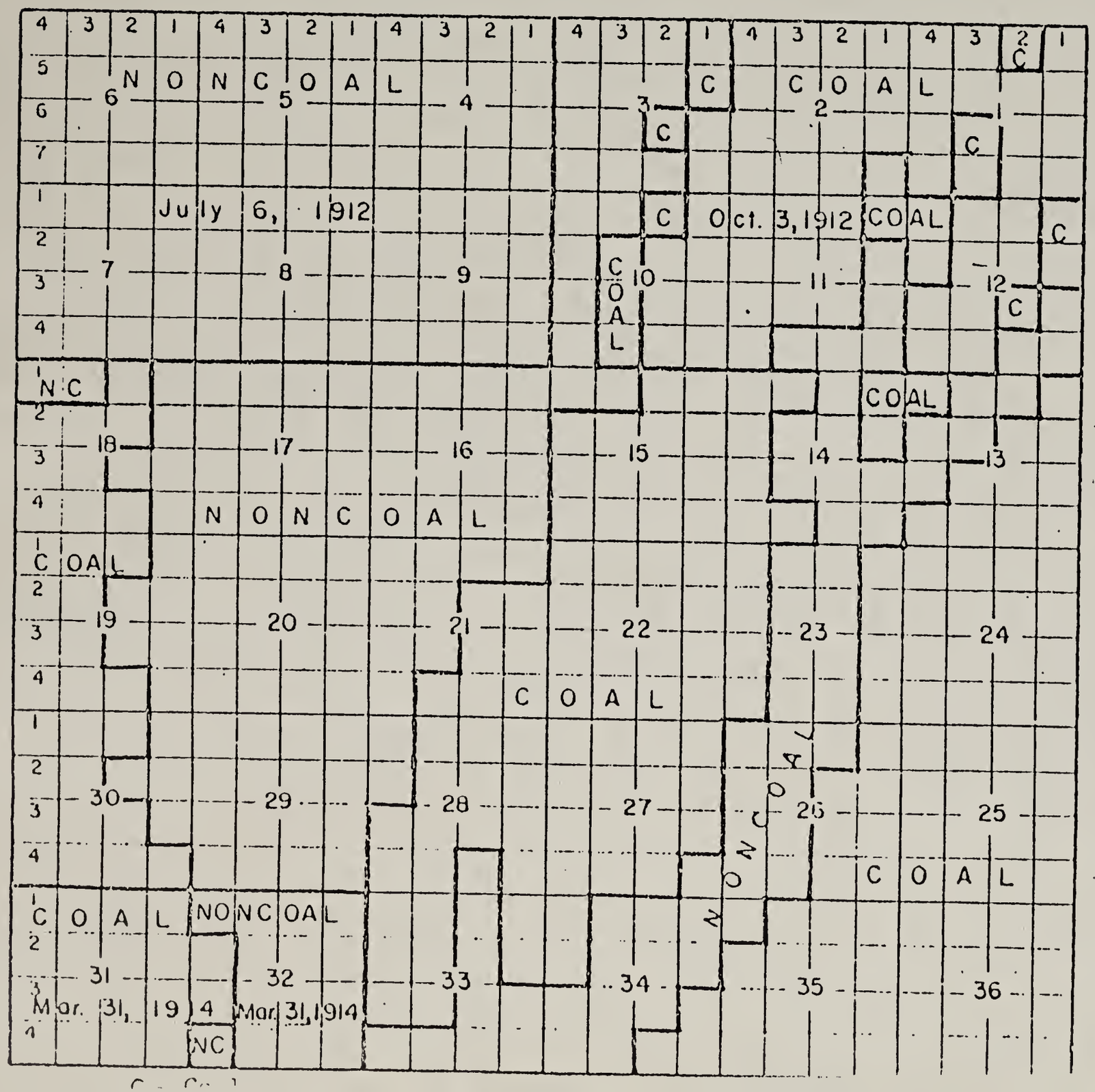
cc: District Geologist
Area Geologist
Regional Manager
Chief, Branch of Mineral & Water Classification

(If minutes are on oil shale, a copy to):

Area Oil Shale Supervisor
Office of Conservation Manager, CR
Bldg. 25, Denver Federal Center
Lakewood, Colorado 80225

NOTE: Last page should not be a signature page only. It should include some text -- or the next to last page should include some signatures.

TOWNSHIP 35 NORTH, RANGE 13 WEST, NEW MEXICO PRINCIPAL MERIDIAN, COLORADO



COAL

CLASSIFIED	Mineral	Nonmineral
Classified by this action	8,648	7,037
Reclassified by this action		40
Prior classification	2,910	4,337
Total acres classified to date	11,558	11,414

NOT CLASSIFIED	
Not withdrawn	
In outstanding withdrawal	
Restored without classification	
Total acres not classified	

Total acres in township 22,972

Classified on dates shown as:

Mineral ☐
Nonmineral ☐
Not classified ☐

New classification approved by the Director, U. S. Geological Survey, Jan. 19, 1970, published in Federal Register v. 35, p. 770, Jan. 24, 1970

Restored from , by Public Land Order published in Federal Register v. , p.

EXHIBIT 2

Specifications for Descriptions of Tracts of Land

for Use in Executive Orders and Proclamations

1942 Edition
Reprinted April 1960 without revision

U.S. GOVERNMENT PRINTING OFFICE
WASHINGTON : 1960

This edition of "Specifications for Descriptions of Tracts of Land for Use in Executive Orders and Proclamations" was issued in 1931, revised in 1942, and reprinted without change pending revision April 1960.

CONTENTS

Chapter		Page
	INTRODUCTION	IV
	EXECUTIVE ORDER No. 7298	1
	EXECUTIVE ORDER No. 9146	3
I.	GENERAL CONSIDERATIONS	5
	Purpose	5
	Authority	5
	Preparation and review	6
	Types of descriptions	7
	Description by reference to official records	7
II.	FORM AND ARRANGEMENT	8
	Titles	8
	Executive orders	8
	Proclamations	9
III.	THE PUBLIC-LAND RECTANGULAR SURVEYS	11
	Terminology	11
	Abbreviations	12
	Preferred order	14
	Area	14
	Examples	15
	Subdivisions that do not conform to standard specifications	18
	Description by perimeter	18
	Adjustment to subdivisions of public-land surveys	18
IV.	METES AND BOUNDS	19
	Definition of terms	19
	Direction of lines	19
	Lengths of lines	20
	Conventional symbols and abbreviations	20
	Sequence and closure	20
	Point of beginning	21
	Natural and artificial boundaries	21
	Public-land tracts by perimeter	22
	Area	22
	Examples	22
V.	MAPS	26
	Maps to be published	26
	Example	27
	Maps forming official supplements	28
VI.	DESCRIPTION BY COORDINATES	29
	Geographic positions	29
	State plane-coordinate systems	30
	Examples	31

INTRODUCTION

In 1930 the Department of State requested the Federal Board of Surveys and Maps to prepare rules and specifications for descriptions of tracts of land appropriate for use in Executive orders and proclamations. The preparation of these specifications was undertaken by the following members of the Board's Committee on Cadastral Surveys:

A. D. Kidder, General Land Office, Chairman;
S. W. Boggs, Department of State;
C. H. Squire, Forest Service;
W. T. Paine, General Land Office.

The original edition, entitled "Specifications for Descriptions of Tracts of Land for Use in Executive Orders and Proclamations," was completed and published in 1931, and reissued, with some corrections as to procedure, in 1941.

The functions connected with the preparation and presentation of Executive orders and proclamations, formerly performed by the Department of State, are now carried on by the Division of the Federal Register, the National Archives, under the provisions of the Federal Register Act, approved July 26, 1935. This has introduced certain changes in procedure and requirements and has rendered inapplicable some of the material contained in the first edition. Further experience in the use of the specifications during the ten-year period which has elapsed since their first publication has indicated the need for additional explanatory text and examples.

A general revision of the publication was, therefore, found advisable, and the work was undertaken in 1940, 1941 and 1942 by the following members of the Board's Committee on Cadastral Surveys and Maps:

W. H. Richards, General Land Office, Chairman;
S. W. Boggs, Department of State;
J. E. Burch, Forest Service;
H. C. Mitchell, U. S. Coast and Geodetic Survey;
P. A. Rosendorn, Bureau of Reclamation;
J. M. Stewart, Office of Indian Affairs.

The revision was nearly complete on March 10, 1942, when the functions of the Federal Board of Surveys and Maps were transferred to the Director of the Bureau of the Budget by Executive Order No. 9094. The completion of this work and the publication of this edition were carried out at the request of the Bureau of the Budget.

EXECUTIVE ORDER

Regulations Governing the Preparation, Presentation, Filing, and Distribution of Executive Orders and Proclamations

By virtue of and pursuant to the authority vested in me by the Federal Register Act, approved July 26, 1935 (49 Stat. 500), and as President of the United States, I hereby prescribe the following regulations governing the preparation, presentation, filing, and distribution of Executive orders and proclamations:

1. Proposed Executive orders and proclamations shall be prepared in accordance with the following requirements:

(*a*) A suitable title for the order or proclamation shall be provided.

(*b*) The authority under which the order or proclamation is promulgated shall be cited in the body thereof.

(*c*) Punctuation, capitalization, orthography, and other matters of style shall conform to the most recent edition of the Style Manual of the United States Government Printing Office.

(*d*) The spelling of geographic names shall conform to the most recent official decisions made pursuant to Executive Orders No. 27–A, of September 4, 1890, No. 399, of January 23, 1906, and No. 6680, of April 17, 1934.

(*e*) Descriptions of tracts of lands shall conform, so far as practicable, with the most recent edition of the "Specifications for Descriptions of Tracts of Land for Use in Executive Orders and Proclamations", published by the Federal Board of Surveys and Maps.[1]

(*f*) Proposed Executive orders and proclamations shall be typewritten on paper approximately 8 by 12½ inches, shall have a left-hand margin of approximately 2 inches and a right-hand margin of approximately 1 inch, and shall be double-spaced, except that quotations, tabulations, or descriptions of land may be single-spaced.

2. The proposed Executive order or proclamation shall first be submitted to the Director of the Bureau of the Budget. If the Director of the Bureau of the Budget approves it, he shall transmit it to the Attorney General for his consideration as to both form and legality. If the Attorney General approves it, he shall transmit it to the Director of the Division of the Federal Register, the National Archives. If it conforms to the requirements of paragraph 1 hereof, the Director of the Division of the Federal Register shall transmit it and three copies

[1] This publication was issued in 1931 and reprinted in 1941. The functions of the Federal Board of Surveys and Maps were transferred to the Director of the Bureau of the Budget by Executive Order No. 9094, dated March 10, 1942.

thereof to the President. If it is disapproved by the Director of the Bureau of the Budget or the Attorney General, it shall not thereafter be presented to the President unless it is accompanied by the statement of the reasons for such disapproval.

3. If the order or proclamation is signed by the President, the original and two copies thereof shall be forwarded to the Director of the Division of the Federal Register for appropriate action in conformity with the provisions of the Federal Register Act: *Provided, however,* That the seal of the United States shall be affixed to the originals of all proclamations prior to such forwarding. The Division of the Federal Register shall cause to be placed upon the copies of all Executive orders and proclamations the following notation, to be signed by the Director or by some person authorized by him: "Certified to be a true copy of the original." The Division of the Federal Register shall number and shall supervise the promulgation, publication, and distribution of all Executive orders and proclamations.

4. The Division of the Federal Register shall cause a limited number of copies of the Executive orders and proclamations not required or authorized to be filed and published under the provisions of the Federal Register Act to be made available in slip form to the appropriate agencies of the Government.

5. The Division of the Federal Register shall file in the National Archives the originals of all Executive orders and proclamations.

6. The signed originals and copies of all Executive orders and proclamations heretofore promulgated and now in the custody of the Department of State shall be transferred to the National Archives.

7. Nothing in this order shall be construed to apply to treaties, conventions, protocols, and other international agreements, or proclamations thereof by the President.

8. This order shall become effective on March 12, 1936, and shall thereupon supersede Executive Order No. 6247, of August 10, 1933.

FRANKLIN D ROOSEVELT

THE WHITE HOUSE,
February 18, 1936.

[No. 7298]

EXECUTIVE ORDER 9146

AUTHORIZING THE SECRETARY OF THE INTERIOR TO WITHDRAW AND RESERVE PUBLIC LANDS

By virtue of the authority vested in me by the act of June 25, 1910, c. 421, 36 Stat. 847, and as President of the United States, I hereby authorize the Secretary of the Interior to sign all orders withdrawing or reserving public lands of the United States, and all orders revoking or modifying such orders: *Provided*, that all such orders shall have the prior approval of the Director of the Bureau of the Budget and the Attorney General, as now required with respect to proposed Executive Orders by Executive Order No. 7298 of February 18, 1936, and shall be submitted to the Division of the Federal Register for filing and publication: *Provided, further*, that no such order which affects lands under the administrative jurisdiction of any executive department, other than the Department of the Interior, shall be signed by the Secretary of the Interior without the prior concurrence of the head of the department or agency concerned.

FRANKLIN D ROOSEVELT

THE WHITE HOUSE,
April 24, 1942.

APPLICABLE TO ALL DOCUMENTS FILED WITH FEDERAL REGISTER

The requirements of paragraph 1 of Executive Order No. 7298 are made applicable to all documents required to be filed in the Office of the Director of the Division of the Federal Register for publication by Section 2.5 of the Federal Register Regulations, effective August 26, 1941.

Chapter I

GENERAL CONSIDERATIONS

PURPOSE

Executive orders and proclamations containing descriptions of land are usually designed to reserve and set apart certain tracts or areas owned or controlled by the Federal Government for specified public uses or purposes. Initial action is ordinarily taken by the bureau or agency exercising administrative control or jurisdiction over the land.[1]

A proclamation is usually an announcement by the President issued to carry out the provisions of an act of Congress. Proclamations are usually of wider public application than Executive orders, as the latter are usually confined to affairs of government. All proclamations are published in the United States Statutes at Large; proclamations and Executive orders are published in the Federal Register under the provisions of the act of July 26, 1935 (49 Stat. 500).

The large permanent reservations are ordinarily established by proclamation, while Executive orders usually involve a more limited and particular purpose and often are of a temporary character. Preliminary to the establishment of a permanent reservation by proclamation, it is frequently found desirable to withdraw temporarily the public lands involved for examination and classification. Subsequent modification of the boundaries of such a reservation may become necessary. The general practice is to accomplish these purposes by Executive order or Public Land order.

In some cases the authorizing legislation specifies the manner in which the action shall be taken. The national monuments are established by proclamation, as required by the act of June 8, 1906 (34 Stat. 225). The national forests are established by proclamation under the provisions of the act of March 3, 1891 (26 Stat. 1103), except in those States where their creation other than by act of Congress is prohibited. If not specified by statute, the accepted practice should be followed.

AUTHORITY

The President has the power to reserve or withdraw lands owned or controlled by the Federal Government for public purposes. In

[1] By Executive Order No. 9146, dated April 24, 1942, the Secretary of the Interior was authorized to sign all orders withdrawing or reserving public lands of the United States and all orders revoking or modifying such orders. Such orders are designated "Public Land Orders" and are prepared in accordance with the requirements of paragraph 1 of Executive Order No. 7298, dated February 18, 1936.

the case of *Crisar* v. *McDowell* (6 Wall. 381) the United States Supreme Court stated:

> From an early period in the history of the government it has been the practice of the President to order, from time to time, as the exigencies of the public service required, parcels of land belonging to the United States to be reserved from sale and set apart for public uses. The authority of the President in this respect is recognized in numerous acts of Congress.

See also *United States* v. *Midwest Oil Co.* (236 U. S. 459).

The act of June 25, 1910 (36 Stat. 847), as amended by the act of August 24, 1912 (37 Stat. 497), generally referred to as the Withdrawal Act, reads in the part pertinent to the present subject as follows:

> That the President may, at any time in his discretion, temporarily withdraw from settlement, location, sale or entry, any of the public lands of the United States including the District of Alaska and reserve the same for water-power sites, irrigation, classification of lands, or other public purposes to be specified in the orders of withdrawals, and such withdrawals or reservations shall remain in force until revoked by him or by an Act of Congress.
>
> SEC. 2. That all lands withdrawn under the provisions of this Act shall at all times be open to exploration, discovery, occupation, and purchase, under the mining laws of the United States so far as the same apply to metalliferous minerals, oil, gas and phosphates: * * *

In an opinion dated June 4, 1941 (40 Op. A. G. 20), the Attorney General approved the legality of a proposed Executive order withdrawing under the general authority of the President certain public lands for a permanent reservation freed of the operation of the mining laws. He held that the act of June 25, 1910, supra, expressly authorized the President to make temporary withdrawals of public lands for certain public purposes contemplated by that act subject to the mining laws but "that the power of withdrawal and reservation for permanent public uses, properly exercised, remains and is independent of the Withdrawal Act of 1910, * * *."

PREPARATION AND REVIEW

Drafts of proposed orders should be carefully prepared with proper regard for established good usage as to terminology, phraseology, punctuation, arrangement, and paragraphing. The description of the tract or tracts of land involved should be technically competent, definite, and susceptible of only one interpretation. It should furnish sufficient information for the identification of the land on the ground.

The originating bureau or agency is responsible for the authenticity and accuracy of the data upon which the land descriptions are based. Field notes and plats of the basic surveys or copies of deed records, together with maps or diagrams showing the lands referred to, should be available for consultation and reference.

Land descriptions should be reviewed by an officer qualified to pass upon the technical sufficiency and form thereof, who has access to the basic survey data and other records from which the draft of the proposed order was prepared. The review should also take into consideration the acceptability and practicability of the boundaries from the standpoint of the administrative agency.

TYPES OF DESCRIPTIONS

Descriptions of land in Executive orders and proclamations are of two general types:

(*a*) Those cases where the location and limits of a tract or tracts are described in specific terms by naming its boundaries; generally termed a metes-and-bounds description.

(*b*) Those cases where the lands are described by reference to designated subdivisions based upon surveys of official character and shown upon plats or maps filed in a public office of record.

The type first mentioned is discussed in Chapter IV.

DESCRIPTION BY REFERENCE TO OFFICIAL RECORDS

The second type of description referred to in the preceding paragraph was considered by the United States Supreme Court in the case of *Cragin* v. *Powell* (128 U. S. 691, 696), from which the following is quoted:

> It is a well settled principle that when lands are granted according to an official plat of the survey of such lands, the plat, itself, with all its notes, lines, descriptions, and land marks, becomes as much a part of the grant or deed by which they were conveyed, and controls so far as limits are concerned, as if such descriptive features were written out upon the face of the deed or grant itself.

This fundamental principle finds wide application in the description of lands located in the original public domain and surveyed under the rectangular system of surveys. Because of the large volume of Executive orders and proclamations involving lands in the public-land States, Chapter III is devoted to the land descriptions, based on the official plats of that system.

This type of description is also used in connection with other kinds of official surveys by specifying designated subdivisions of such surveys, which are shown upon plats filed in a public office of record. For example, parcels may be described by lot and block number of a city or townsite subdivision, based upon a properly identified official plat.

Descriptions based on recorded plats and maps of the character just referred to by designation of subdivision shown thereon should identify the particular plat or map by title and date, giving the name and location of the place of record as well as the approving or certifying authority.

Chapter II

FORM AND ARRANGEMENT

Executive Order No. 7298 of February 18, 1936, under Section one, prescribes certain requirements in connection with the preparation of Executive orders and proclamations. The following suggestions relative to the form and arrangement of such documents should also be followed.

1. Titles

The title should indicate, in two or three lines: (a) either the purpose or the content of the document, and (b) the geographic locality of the area, as the State or Territory, with further details of location whenever appropriate, if they can be briefly indicated.

The titles of Executive orders and proclamations are usually arranged in three or more lines in capital letters, with no periods at the ends of the lines. The following examples show that in a proclamation the order of the lines of the title is the exact reverse of that in an Executive order:

(*a*) EXECUTIVE ORDER

RESERVING A TRACT OF LAND FOR USE BY THE
DEPARTMENT OF COMMERCE AS A BEACON SITE

WASHINGTON

(*b*) ROCKY MOUNTAIN NATIONAL PARK--COLORADO

BY THE PRESIDENT OF THE UNITED STATES OF AMERICA

A PROCLAMATION

2. Executive Orders

(*a*) The initial paragraph begins with the citation of authority. The form to be used is shown in paragraph 3 (c).

(*b*) The date paragraph at the end of the order is placed to the left. The arrangement, punctuation, and capitalization should conform to the following example:

THE WHITE HOUSE,
May 1942.

3. Proclamations

A proclamation is written in more formal style than an Executive order. The following points should be noted:

(*a*) The initial and immediately succeeding paragraphs which state the reason and purpose of the action customarily begin with the lead word

WHEREAS,

(*b*) The paragraph announcing the action begins as follows with capitalization and punctuation as indicated:

NOW, THEREFORE, I, FRANKLIN D. ROOSEVELT,
President of the United States of America,

(*c*) The citation of authority is usually given in the same paragraph, immediately after the title. The following form should be followed:

- - - - - by virtue of the power (or authority) vested in me by section 24 of the act of March 3, 1891, 26 Stat. 1103 (U.S.C. title 16, sec. 471), - - - -

DONE at the city of Washington this day of (month), in the year of our Lord nineteen hundred and forty-two, and of the Independence of the United States of America the one hundred and sixty-seventh.

By the President:

Secretary of State

Chapter III

THE PUBLIC LAND RECTANGULAR SURVEYS

TERMINOLOGY

That part of the United States acquired by the Federal Government by cession from the States, treaty and purchase, now embraced in the States of Alabama, Arizona, Arkansas, California, Colorado, Florida, Idaho, Illinois, Indiana, Iowa, Kansas, Louisiana, Michigan, Minnesota, Mississippi, Missouri, Montana, Nebraska, Nevada, New Mexico, North Dakota, Oklahoma, Ohio, Oregon, South Dakota, Utah, Washington, Wisconsin, Wyoming, and the Territory of Alaska, comprised the original public domain. The rectangular system of surveys has been extended or is now in progress over this area as the basis for the identification, administration, and disposal of the public lands.

Description of lands within the scope of the public-land rectangular surveys should conform to the accepted nomenclature of that system, citing the name of the proper reference meridian, the appropriate township and range numbers and, where necessary, the section and sectional subdivisions shown upon the official plats of survey. Each reference meridian has its own base line; and, therefore, the words "and base line" are usually omitted. The name of the reference meridian should be spelled in full. If the lands have not been surveyed, the description should conform to the legal subdivisions that will, when established, include the lands.

The Manual of Instructions for the Survey of the Public Lands of the United States (Edition of 1930), published by the General Land Office, gives a detailed description of the rectangular system of surveys and nomenclature. On page 138 of that publication is a table showing the principal meridians and base lines. (See map facing page 31 showing these lines and areas governed thereby.)

The township approximately six miles square, containing 36 sections, each one mile square, numbered from 1 to 36, according to the plan shown in Fig. 1, is the unit of survey. The section lines are usually surveyed from south to north and from east to west, with any excess or deficiency placed against the north and west boundaries of the townships.

The section is subdivided into quarter sections by straight lines, connecting established quarter-section corners on opposite boundaries. This unit is usually designated by symbol in tabular descriptions

(NW¼ sec. 10; SE¼ sec. 22). The 40-acre unit, resulting from the subdivision of quarter sections into quarter-quarter sections, is designated by symbol, as NW¼NE¼ sec. 10; SE¼NW¼ sec. 22. Occasionally the quarter-quarter section is further subdivided into its aliquot parts by mid-point subdivision. The resulting 10-acre unit is designated by symbol as NE¼NW¼SW¼ sec. 22.

Contiguous units may be combined. For example, if both NW¼ sec. 10 and SW¼ sec. 10 are included, the symbol W½ sec. 10 is used.

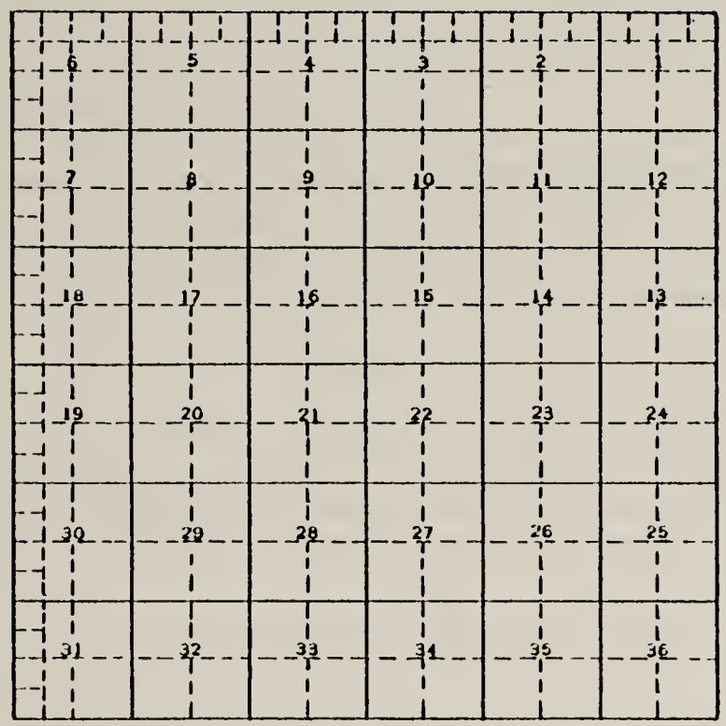


Figure 1.—Showing plan of numbering sections.

Where NE¼NW¼ sec. 22 and SE¼NW¼ sec. 22, are included, the resulting 80-acre unit can be designated E½NW¼ sec. 22. In using symbols, the usual punctuation is omitted. Note that the period is omitted after N, NE, S, SE, etc., and that there is no comma and no space between symbols indicating a quarter-quarter section (NE¼SE¼ sec. 10).

The fractional units, usually resulting from the subdivision of the quarter sections in the northern tier and western range of sections or developed because of the existence of meanderable bodies of water or irregular boundaries of claims, are designated by lot numbers (lot 1, sec. 4; lot 1, sec. 15).

ABBREVIATIONS

The words "township" and "range" and the designations "north" or "south", "east" or "west" are sometimes written in full when used in the text, but the land description itself should be in tabular form and these terms abbreviated and capitalized where appropriate. The principal abbreviations are as follows:

Township(s)	T., Tps.
Range(s)	R., Rs.
Section(s)	sec., secs.
North	N.
Northeast	NE., etc.

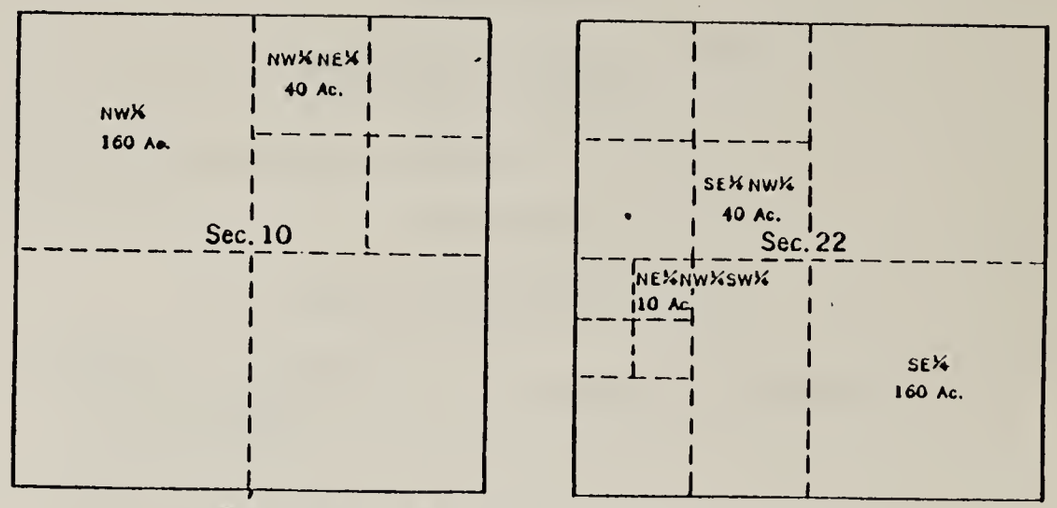


Figure 2.—Showing normal subdivisional units.

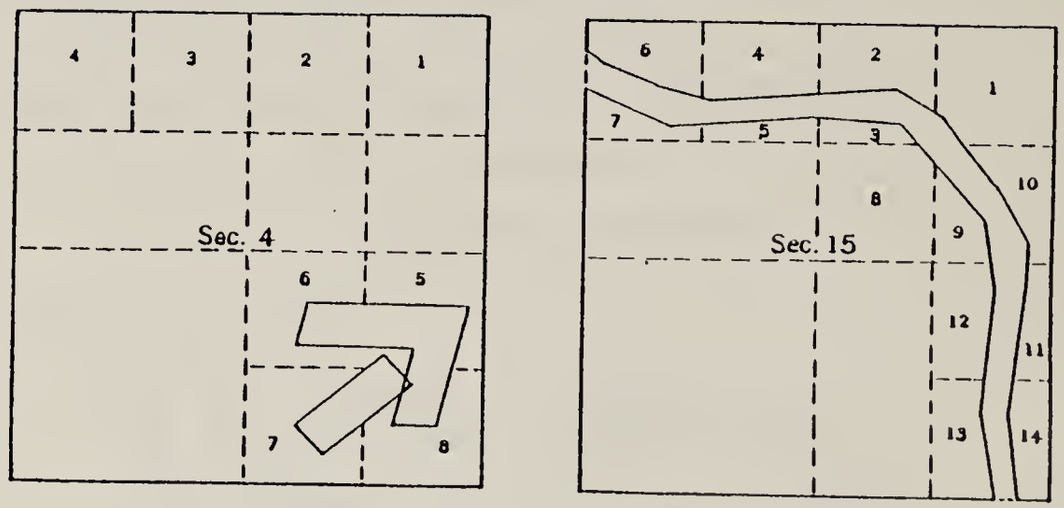


Figure 3.—Showing fractional lots.

Where two or more township units are to be grouped in the description, the plural abbreviation "Tps." should always be used, even though all the townships have the same number north or south of the base line. The term "range" is abbreviated in the singular or plural as the meaning may require, for example:

Tps. 3 S., Rs. 16 and 17 W.
Tps. 4 and 5 N., R. 14 W.
Tps. 1, 2, and 3 N., Rs. 6, 7, and 8 W.

PREFERRED ORDER

The preferred order of listing is to begin with the lowest-numbered section in each township, giving first the lot numbers in order, then the subdivisions within each quarter section, in the order NE, then the NW, SW, and SE; if parts of the quarter sections are to be described, the same order is to be observed. If several townships are included, the primary order is determined by the range number, beginning with the lowest, and within each range by the township numbers also beginning with the lowest.

Where townships north and south of the base line or east and west of the reference meridian or both are involved, the order of listing is optional but usually follows the order given above; namely, first those north and east of the initial point, followed by those north and west, south and west, and south and east in the order named.

AREA

In some cases, a statement of the total area follows the description. If the lands described are entirely surveyed, the actual acreage as shown upon the official plats of survey should be used. Where unsurveyed land is included, the approximate area should be given in even acres.

Descriptions containing public land only should carry a statement reading as follows:

> The area (or areas) described aggregates (or aggregate) _____ acres.

Where both public and nonpublic lands are included, the following statement should be used:

> The areas described, including both public and nonpublic lands, aggregate _____ acres.

EXAMPLES OF DESCRIPTIONS OF LANDS BASED UPON THE PUBLIC LAND RECTANGULAR SURVEYS

Example No. 1

Fourth Principal Meridian
T. 31 N., R. 18 W., sec. 9, SE¼.

The area described contains 160 acres.

Example No. 2

Fifth Principal Meridian

T. 160 N., R. 66 W.,
sec. 6, lots 4 to 7, inclusive, SE¼NW¼, and E½SW¼;
sec. 7;
sec. 17, W½SW¼;
sec. 18, NE¼;
sec. 20, W½NW¼ and SW¼.
T. 160 N., R. 67 W., sec. 1, SE¼.

The areas described aggregate 1,550.18 acres.

Example No. 3

Black Hills Meridian

T. 3 S., R. 1 E.,
sec. 8, SE¼;
sec. 21;
sec. 28, E½, N½NW¼, and NE¼SW¼;
sec. 31, lots 2 and 4, NW¼NE¼, NE¼NW¼, and SE¼;
sec. 34, W½NE¼, W½, W½SE¼SE¼, and W½SE¼.
T. 5 S., R. 2 E.,
sec. 17, N½;
sec. 22, N½;
sec. 34, N½.
T. 5 S., R. 3 E.
T. 6 S., R. 3 E.,
sec. 4, lots 1, 2, 3, 7, and 8, SW¼NE¼, S½NW¼, and SE¼;
secs. 16, 17, and 18.

The areas described, including both public and nonpublic lands, aggregate 28,184.79 acres.

Example No. 4

Salt Lake Meridian

T. 39 S., R. 10 W.,
sec. 31, lots 4 to 14, inclusive, and lots 19 to 30, inclusive.
T. 40 S., R. 10½ W.,
sec. 1;
sec. 2, unsurveyed.
T. 38 S., R. 11 W.,
secs. 31, 32, and 33.
T. 39 S., R. 11 W.,
secs. 4 to 9, inclusive, and secs. 16 to 21, inclusive, partly unsurveyed;
sec. 24, NE¼ and S½;
secs. 25 to 29, inclusive, and secs. 33 to 36, inclusive.
T. 40 S., R. 11 W.,
secs. 2, 3, 4, 9, 10, 15, 16, 21, 22, 27, 28, 33, and 34.
T. 41 S., R. 11 W.,
sec. 4;
sec. 5, E½;
sec. 8, NE¼;
secs. 9, 16, and 21.
T. 38 S., R. 12 W.,
sec. 10, lots 3 to 10, inclusive;
sec. 11, S½;
sec. 12, S½;
secs. 13, 14, and 15;
sec. 21, E½;
secs. 22 to 28, inclusive;
sec. 29, lot 1 and lots 3 to 8, inclusive;
secs. 33 to 36, inclusive.
T. 39 S., R. 12 W.,
secs. 1 to 4, inclusive, and secs. 9 to 15, inclusive, partly unsurveyed.
sec. 16, E½;
secs. 22, 23, and 24, partly unsurveyed.

Example No. 5

Mount Diablo Meridian

T. 45 N., R. 21 E.,
secs. 1, 2, 4, 6, and secs. 8 to 17. inclusive.
T. 46 N., R. 21 E.,
secs. 20 to 29, inclusive, E½ sec. 30, E½ sec. 31, and secs. 32 to 36, inclusive.
T. 46 N., R. 22 E.,
secs. 4 to 9, inclusive, secs. 11 to 14, inclusive, and secs. 16 to 21, inclusive, partly unsurveyed.
T. 45 N., R. 23 E.,
W½SE¼ sec. 8, E½ sec. 16, W½NE¼ sec. 20 unsurveyed, W½SW¼ sec. 28, and secs. 29 to 32, inclusive.

Example No. 6

Salt Lake Meridian

Tps. 1, 2, and 3 N., R. 14½ W., unsurveyed.
Tps. 1 to 4 N., R. 15 W., partly unsurveyed.
T. 1 S., R. 18 W., secs. 1 to 18, inclusive.
Tps. 1 to 5 S., R. 19 W., partly unsurveyed.
T. 6 S., R. 19 W., sec. 33 and that part of sec. 34 lying northwest of Snake Creek.

Example No. 7

Sixth Principal Meridian

T. 37 N., R. 67 W.,
secs. 4 to 9, inclusive, secs. 16 to 21, inclusive, and secs. 28 to 33, inclusive.
T. 38 N., R. 67 W.,
secs. 4 to 9, inclusive, secs. 16 to 21, inclusive, and secs. 28 to 33, inclusive.
T. 39 N., R. 67 W.,
secs. 4 to 9, inclusive, secs. 16 to 21, inclusive, and secs. 28 to 33, inclusive.
T. 40 N., R. 67 W.,
secs. 4 to 9, inclusive, secs. 16 to 21, inclusive, and secs. 28 to 33, inclusive.
T. 41 N., R. 67 W.,
secs. 1 to 24, inclusive, and secs. 28 to 33, inclusive.
Tps. 42 to 44 N., R. 67 W.
Tps. 37 to 44 N., R. 68 W.
Tps. 38 to 44 N., R. 69 W.
Tps. 38 to 43 N., R. 70 W.
T. 44 N., R. 70 W.,
secs. 1, 2, 3, secs. 10 to 15, inclusive, secs. 22 to 27, inclusive, secs. 34, 35, and 36.

SUBDIVISIONS THAT DO NOT CONFORM TO STANDARD SPECIFICATIONS

In many of the very old surveys under the rectangular system, especially in the southern public-land States, the township subdivisions and the units within the sections do not conform to all the standards shown above, and there are sometimes other complications that must receive special consideration in the preparation of land descriptions. Under such conditions it is advisable to obtain a statement from the General Land Office relative to the appropriate terms to be employed.

DESCRIPTION BY PERIMETER

The proper form of description for all lands within the scope of the public-land rectangular surveys is the tabular form shown in the preceding examples, using the accepted nomenclature of the system. This form is to be preferred to the perimeter method of description, specifying the boundaries of a tract by the bearings and distances of its perimeter along certain township, section, and minor subdivision lines. The latter is in effect a metes-and-bounds description and necessitates platting the tract before reference can be made to the survey and tract-book records of the General Land Office. The use of the perimeter form of description and variations thereof is discussed in the chapter on Metes and Bounds.

ADJUSTMENT TO SUBDIVISIONS OF PUBLIC LAND SURVEYS

Boundaries of lands within the scope of the public-land rectangular surveys should conform to the approved subdivisional surveys whenever practicable. Where withdrawals have been made in advance of survey, the regulations of the Department of the Interior require that if possible a subsequent adjustment be made to the lines of legal subdivision.

"Hereafter, upon receipt of the returns of a survey, the Commissioner of the General Land Office shall cause the tract books in his office to be examined and if it appears that any part of the area stands withdrawn in advance of survey upon any recommendation of any bureau of this or another department, he shall ascertain whether the lands so withdrawn are capable of adjustment by reference to the legal subdivisions shown upon the plats of survey, and if so, upon acceptance of the survey, he will advise the proper local land officers of such adjustment, in order that notation thereof may be made upon their records." (42 L. D. 318.)

Chapter IV

METES AND BOUNDS

DEFINITION OF TERMS

The location and limits of a tract of land may be defined by describing its boundaries; by naming natural or artificial monuments to, from or along which they run; by stating the lengths and directions of the lines connecting successive monuments; or by giving the boundaries of abutting tracts of land.

A monument may consist of an object or mark which serves to identify the location of a line constituting a part of the boundary; it may be either natural such as a river, lake, ledge of rock, tree or ridge; or artificial such as a wall, fence, ditch, marked stone or post.

The type of metes-and-bounds description most commonly used in Executive orders and proclamations is based upon an actual survey of the tract of land involved. The lengths and directions of the lines forming the boundaries are ascertained by the survey and the record thereof describes the monuments marking the corners or angle points. The plat and field notes furnish the data for the description.

If the lines of an adjoining tract of land form a common boundary with the tract in question, the description should note this fact, identifying the adjoining tract by the name of the owner, survey designation, or other appropriate means.

DIRECTION OF LINES

The direction of a line in land surveying is generally expressed by giving the angle from the meridian [1] within one of the four quadrants, referred to either the north or the south point as may be appropriate. When so expressed (e. g. N. 70°19′ E.; S. 24°10′ W.), it is called the "bearing" of the line and unless otherwise stated, is to be interpreted as a "rhumb" line—that is, one that maintains a constant angle with the meridian throughout its length.

Occasionally the basic data have been developed in the execution of geodetic surveys and the direction of certain lines may be given by recording the angles which such lines make with the meridian measured clockwise from south. In such cases the lines are generally to be regarded as great circles rather than rhumb lines and the angles referred to are designated as azimuths. At any two points on a great

[1] As defined by the axis of the earth's rotation.

circle, the forward and back azimuths of the line differ by 180° plus or minus the angle of convergence of the meridians passing through the points. Where either forward or back azimuths or both are given, they should be so designated.

LENGTHS OF LINES

In land surveying, horizontal distances are generally measured and recorded at the mean elevation of the ground. In some cases a general ground-level datum may be used for an entire survey or group of surveys. However, in geodetic surveys, the horizontal distances are adjusted to sea level.

The unit of measurement employed will usually depend upon the particular class of surveys upon which the description is based. The foot unit is used in many metes-and-bounds surveys and in town-site and city subdivisions; the chain is the linear unit in the public land surveys; and the meter is employed in the cadastral surveys of the Philippine Islands and surveys of similar character. Other units such as the vara and the arpent were employed in the surveys of the Spanish, Mexican and French land grants but slightly different values for these units are found in various localities. Consequently, in using data involving these units, it is necessary to ascertain definite equivalents in terms of the foot or chain units which are to be used in the descriptions. For this purpose, examination should be made of the early surveying records and court decisions.

CONVENTIONAL SYMBOLS AND ABBREVIATIONS

The conventional symbols for degrees (°), minutes (′), and seconds (″) of arc should usually be employed in giving the direction of lines.

The abbreviations for the units most frequently used are:

Chain(s)	ch., chs.
Link(s)	lk., lks.
Foot (feet)	ft.

SEQUENCE AND CLOSURE

The bearings and distances of the courses connecting the turning points or corners of a tract are usually given in regular order around the perimeter thereof. Each course is written on a separate line and if any corner or course is coincident with a corner or course of another tract, notation should be made of this fact. The final course should note the return to the place or point of beginning.

An exception to the foregoing is found in the description of a tract of specified width on each side of a definitely described center line such as a right of way. In such a case the terminal point as well as the beginning point should be fully identified.

POINT OF BEGINNING

The location of a tract of land may be defined by stating its position in relation to established monuments of known position or by stating its geographic position (latitude and longitude). In metes-and-bounds descriptions this is generally accomplished by a complete description of the point of beginning. The information furnished should be sufficient to enable a competent surveyor to locate and identify the initial point. Frequently a statement regarding nearby topographic or cultural features or objects is of great value. The general location (State, county, etc.) is usually given in the first part of the Executive order or proclamation and need not be repeated in the description.

If the point of beginning is an established corner of an official survey or is connected by survey to such a corner, the latter should be described by corner and survey number or other appropriate designation without detailed description of the monument itself. The latitude and longitude should be given unless the beginning point is a corner of the public-land rectangular surveys or connected by survey to such a corner.

NATURAL AND ARTIFICIAL BOUNDARIES

Occasionally the boundaries of a tract are defined entirely or in part by natural monuments, such as streams, lakes, divides, or straight lines connecting prominent features of topography. In such cases it is essential that each boundary be described so definitely and specifically that there is no uncertainty as to its identification.

In the case of a stream or river, the middle of the channel or one bank is usually specified. Facing downstream, the bank on the left hand is termed the left bank and that on the right hand the right bank. Where lakes, large rivers, or tidal waters are involved, the intended elevation or stage of water should be specified, such as low-water mark, mean high-water mark, or mean high tide.

Similarly, in referring to a natural monument such as a divide or peak, or to such permanent artificial monuments as highways, railroads, ditches, the specific line or point intended to be used should be described with sufficient particularity as to be capable of definite identification on the ground.

In connection with the type of boundaries just referred to, it is important that the agency preparing the Executive order or proclamation consider not only the technical sufficiency and form of the description but the feasibility and practicability of the boundary from the viewpoint of proper administration. For example, the selection of a boundary described as paralleling a railroad or highway at a distance of five miles therefrom should be avoided as such a line would be difficult to establish and impracticable from an administrative standpoint.

PUBLIC LAND TRACTS BY PERIMETER

The proper form of description for lands within the scope of the public-land rectangular surveys is the tabular form discussed in Chapter III. By using the direct nomenclature of that system, the description can be compared with the tract book and other records of the General Land Office. However, in localities where the public-land surveys are largely incomplete and where it is administratively desirable that part of the boundaries follow natural monuments such as rivers or divides, an exception to the above stated rule is sometimes made. In such situations the land in question may be described in whole or in part by specifying its boundaries around the perimeter thereof as following certain township, section, or minor subdivision lines. The unsurveyed areas are subject to adjustment to the subdivisions shown upon the plats of survey after approval.

AREA

A statement of the area of the tract usually follows the description and in most cases is expressed in acres. Where justified by the accuracy of the survey, the value should be carried to the nearest hundredth of an acre. Approximate areas should be indicated as such and given in even acres.

EXAMPLES OF METES-AND-BOUNDS DESCRIPTIONS

Example No. 1

Beginning at corner No. 1, a hemlock post, 4 in. square, 24 in. above ground, located on the Takotna Highway about 1/4 mile southeasterly from its intersection with the left bank of Kuskokwim River and in approximate latitude 62°52' N., longitude 155°40' W. Corner No. 2 of U. S. Survey 999 bears N. 26°59' W., 327.6 ft.

From corner No. 1, by metes and bounds,

S. 25°43' W., 1900 ft., to corner No. 2;
S. 57°30' W., 3000 ft., to corner No. 3;
S. 32°30' E., 830 ft., to corner No. 4;
N. 57°30' E., 4000 ft., to corner No. 5;
N. 25°43' E., 1650 ft., to corner No. 6;
N. 34°17' W., 550 ft., to corner No. 7;
S. 85°38' W., 871.6 ft., to corner No. 1,
the place of beginning.

The tract as described contains 121.66 acres

Example No. 2

Beginning at corner No. 1, on the south shore of Humboldt Harbor, at mean high tide, in latitude 55°19'12" N., longitude 160°31'07" W., from which U. S. Location Monument No. 1146 bears S. 79°32'51" W., 28.44 chs. distant.

From the initial point,

South, 13.44 chs. to corner No. 2, identical with corner No. 3, U. S. Survey No. 1400;
N. 67°41' E., 15.93 chs. to corner No. 3;
North, 13.44 chs. to corner No. 4 on south shore of Humboldt Harbor at mean high tide;
Thence with meanders of Humboldt Harbor at mean high tide,
S. 70°26' W., 2.60 chs.,
S. 0°15' W., 1.50 chs.,
S. 59°31' W., 1.50 chs.,
S. 73°02' W., 5.00 chs.,
S. 75°22' W., 2.50 chs.,
S. 77°39' W., 3.90 chs. to corner No. 1,
the place of beginning. The tract as described contains 18.65 acres.

Example No. 3

Beginning at the northerly corner of Parcel No. 1 on the boundary of Land Court Application 900, the azimuth (measured clockwise from south) and distance to United States Military Reservation Monument No. 67 is 161°52', 2,352.64 feet, the coordinates of monument No. 67, referred to Government Triangulation Station "Uka" being 5,263.18 feet north and 10,120.63 feet west.

From the initial point by azimuths and distances,

351°54', 1,183.36 feet, along Land Court Application 900 to a point;
161°46'30", 334.59 feet, along the new west side of Kamehameha Highway, to a point;
On a curve to the right, with a radius of 1,969.86 feet, long chord azimuth and distance being 166°39'20"; 335.19 feet, to a point on said highway;

187°44'08", 123.07 feet, along the highway to a point;
On a curve to the left along the highway, with a radius of 1,472.50 feet, long chord azimuth and distance being 179°49'04", 405.68 feet to the point of beginning.

The tract as shown on map No. dated on file in the office of the Department Engineer, Fort , Territory of Hawaii, contains 1,195 acres.

Example No. 4

Beginning at the confluence of the Chvilnuk and Yukon Rivers in approximate latitude 61°58'15" N., longitude 162°48'20" W.,

Thence northeasterly upstream along the center of Chvilnuk River to its source in the Tundadula Mountains;
Easterly along the summit of the Tundadula Mountains to the source of the Bonasila River;
Southeasterly downstream along the middle of the main channel of the Bonasila River to its junction with the Stuyahok River;
Southerly upstream along the middle of the main channel of the Stuyahok River to a point due west of the source of Mountain Creek;
East to the source of Mountain Creek;
Southerly downstream along the center of Mountain Creek to its junction with Tucker's Slough;
Southerly along the center of Tucker's Slough to its junction with the Yukon River;
Southerly and westerly downstream along the right bank of the main channel of the Yukon River at mean high-water mark to the mouth of the Chvilnuk River and the place of beginning.

The tract as described contains approximately 1,900,000 acres.

Example No. 5

Gila and Salt River Meridian

Beginning at the corner of Secs. 5, 6, 31, and 32, Tps. 17 and 18 S., R. 3 W., on the southern boundary of the Papago Indian Reservation;
Thence south approximately 5½ miles to the International Boundary between the United States and Mexico;
Northwesterly along the International Boundary to intersection with the position for the third

meridional section line through unsurveyed T. 17 S., R. 8 W.;
North on the third meridional section line through Tps. 17, 16, 15, and 14 S., R. 8 W., (unsurveyed), to the point for the corner of Secs. 15, 16, 21, and 22;
East on the third latitudinal section line through Tps. 14 S., Rs. 8, 7, 6, and 5 W., (partly unsurveyed), to the corner of Secs. 13, 18, 19, and 24, Tps. 14 S., Rs. 4 and 5 W., on the west boundary of the Papago Indian Reservation;
Southerly along the boundary of the Papago Indian Reservation to the place of beginning.

The area as described contains approximately 330,700 acres, subject to adjustment to lines of public land surveys.

Example No. 6

A right of way 40 ft. wide, the center line of which is described as follows:
Beginning at station No. 1, on the boundary between the United States Military Reservation and Land Court application 1000 (amended), from which the azimuth and distance to United States Military Reservation Monument No. 80 is 182°36'40", 6.55 ft.
From station No. 1, by azimuths and distances,
109°55'48", 444.2 ft. to station No. 2;
159°44'10", 183.8 ft. to station No. 3;
209°07'56", 208.3 ft. to station No. 4;
139°02'05", 414.6 ft. to station No. 5;
173°38'45", 325.5 ft. to station No. 6;
201°43'50", 505.9 ft. to station No. 7;
156°57'40", 435.1 ft. to station No. 8;
186°41'20", 477.9 ft. to station No. 9;
165°16'45", 345.4 ft. to station No. 10;
187°43'20", 1092.1 ft. to station R 1, at the southern intersection of the center of the Honolulu-Waialua road with the Military Reservation boundary between monuments No. 79 and No. 80, and being determined by the following azimuths and distances;
To monument No. 79, 351°53'12", 2179.0 ft.;
To monument No. 80, 171°53'12", 3930.2 ft.;

The right of way is shown on map No. in the office of the Judge Advocate, Honolulu, Territory of Hawaii, dated , file No.

Chapter V

MAPS

MAPS TO BE PUBLISHED

Paragraph (k), Section 2.5, of the Federal Register Regulations effective August 26, 1941, applicable to the preparation of documents required to be filed in the Office of the Director of the Division of the Federal Register for publication, provides as follows:

> (k) The inclusion of illustrations, maps, forms, and similar material as part of the documents should be avoided wherever possible. Where it is necessary to publish maps and illustrations they shall be reduced to a size not greater than 7 x 10 inches and be line cuts only. In such cases original drawings must be forwarded to the Division with the documents of which they are a part.

Under some conditions it is essential that a map be incorporated as an integral part of an Executive order or proclamation, either in place of a written description or in addition thereto. Such a map usually has to be reduced for publication in the Federal Register. The scale and detail should be so planned as to be legible when reproduced within the size above specified. The reduction in making the printing plate should not exceed one-third, consequently the drawing should have maximum dimensions of 10.5 x 15 inches.

The following requirements should be observed in the preparation of the map: (See Fig. 4 for example)

(*a*) The title should be identical with that of the Executive order or proclamation in so far as practicable.

(*b*) The date should be the same as that of the Executive order or proclamation.

(*c*) Two or more parallels and meridians, with the latitude and longitude of each, should be shown where the size of the tract warrants; otherwise the latitude and longitude of one point and an orientation arrow should be shown.

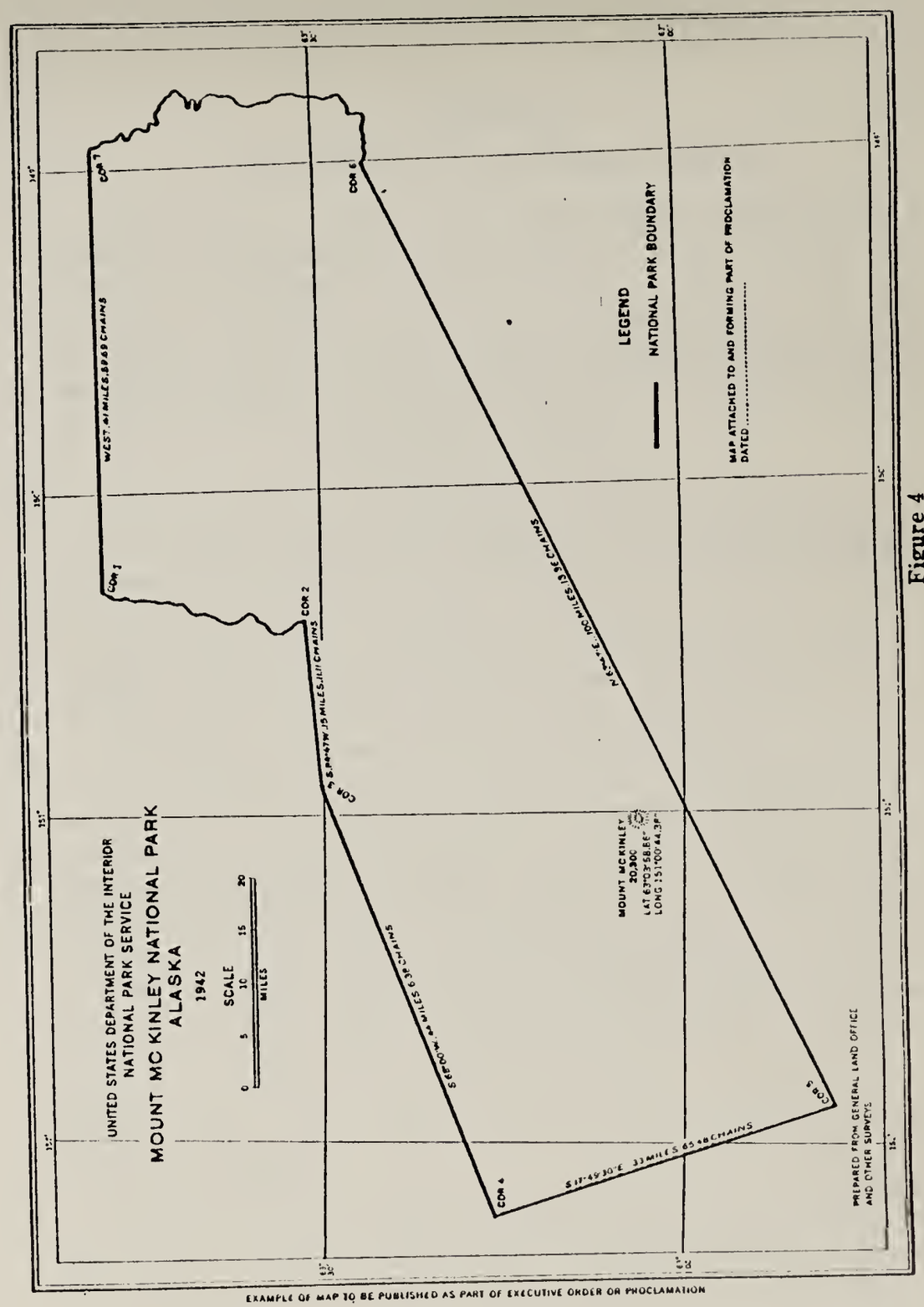
(*d*) The map should carry an appropriate graphic scale.

(e) The lines and lettering should be in black only and legible when reduced for publication.

(f) The name of the originating bureau or agency, list of sources, and a statement that the map is attached to and forms a part of the Executive order or proclamation should be shown.

The text of the Executive order or proclamation should include a clause, reading substantially as follows:

* * * the boundaries (or tract) shown upon the map attached hereto and made a part hereof * * *



EXAMPLE OF MAP TO BE PUBLISHED AS PART OF EXECUTIVE ORDER OR PROCLAMATION

Figure 4

MAPS FORMING OFFICIAL SUPPLEMENTS

Where the reduction in scale is so great as to impair the legibility of the map, the publication thereof as an integral part of the Executive order or proclamation should be avoided. In such cases it is preferable to file a full-scale map as an official supplement. The principle that an official plat or map cited in a deed or other document is in fact a part of such document as much so as if incorporated in it, has already been referred to in Chapter I.

This principle may be utilized under the conditions just referred to by the originating bureau or agency. A properly identified map supplement, bearing the certificate of an officer of the bureau or agency, may be placed of record in the files thereof.

A file of maps which serve as official supplements to Executive orders or proclamations should comply with the following requirements:

1. The maps should be adequately indexed, classified, and described.
2. They should be available for inspection and consultation by interested persons.
3. Copies of the maps should be available for sale to the public at uniform listed prices.

Full-scale copies of these maps may be folded and attached to printed copies of Executive orders and proclamations for administrative use or for sale at cost to interested persons.

Where official supplements are used, the text of the Executive order or proclamation should include a statement reading substantially as follows:

> The boundaries (or tract) described (or referred to) are shown upon_____(bureau or agency) map entitled_____, dated_____, filed in_____(place of filing), supplementing this Executive order (or proclamation).

Chapter VI

DESCRIPTION BY COORDINATES

The location of a point on the surface of the earth may be accurately described by expressing its position on any well-established system of coordinates.

Two general classes of coordinates are available for such use in the Unitd States: Geographic positions (latitudes and longitudes), and plane-coordinate (x and y) positions which are derived from and are dependent upon geographic positions.

GEOGRAPHIC POSITIONS

The United States is covered by a network of triangulation and traverse, which determines the latitudes and longitudes of thousands of marked points, based on a standard geodetic datum known as the North American datum of 1927.

Any survey which is satisfactorily connected with at least two stations, whose positions are known on the North American datum of 1927, may be computed and recorded on that datum.

As this same condition pertains to earliest datums, now superseded by the datum of 1927, it is essential that all computations and recorded values on a geodetic datum be accompanied by a legend identifying the datum used. There is nothing in the form of a geographic position itself to identify it as being on a certain geodetic datum, or, for that matter, as an independent astronomical position.

The use of astronomical methods in determining a geographic position should be avoided, since each individual astronomical position is subject to certain local influences which prevent its direct and accurate coordination with other points determined by such methods. However, astronomical positions may be used in determining a geodetic datum, which, in turn, serves as a base for purposes of computation and record.

Where a boundary is defined by expressing the geodetic latitudes and longitudes of its corners, the forward and back azimuths and the lengths of the lines forming the boundary should also be given. These data should be arranged in the tabular form generally adopted for such data by the various Federal survey bureaus. The descriptions of the station and corner sites, and of their monuments and marks should follow the table of positions, and be in short paragraphs arranged in the same sequence as the positions. The example

is taken from the report of the International Boundary Commission, United States and Canada, Northwesternmost Point of Lake of the Woods to Lake Superior.

STATE PLANE-COORDINATE SYSTEMS

For each State in the Union, the United States Coast and Geodetic Survey has devised a system of plane-rectangular coordinates for the purpose of defining and stating the positions or locations of established monuments and other points with reference to a point of origin. Each such State system comprises one or more zones, each zone having its own plane-rectangular map projection, called a grid, derived from and mathematically dependent upon the North American datum of 1927, which is the standard geodetic datum for the horizontal control survey of the United States. Each grid is defined by naming the spherical map projection on which it is based, stating the geographic position of its origin, and giving its scale relationship to the geodetic datum.

State-wide systems of plane-rectangular coordinates have been approved by statute in New Jersey, Pennsylvania, New York, North Carolina, Maryland, and Massachusetts. The use of coordinates, based upon these or county or municipal systems approved by statute, should be in accordance with the official regulations governing such use. An essential prerequisite to the proper utilization of these systems is the establishment of an adequate number of adjusted control stations.

Where the survey of a tract of land has been connected by an acceptable survey to two monuments whose coordinates on a State system are known, the coordinates on the State system of all corners of the tract can be computed from the grid azimuths and lengths of the boundary lines by the usual methods of latitudes and departures.

Where a boundary is described by stating the plane coordinates of its corners on a State system, appropriate reference to the system used must be incorporated in the description. In a State whose plane-coordinate system has been approved by act of legislature, the official title of the State system should appear in the description, and the statute cited. Example: "Maryland Coordinate System (Chapter 628, Laws of Maryland, 1939)."

Where a description having the form of metes and bounds is supplemented by the addition of the plane coordinates of the land corners on a State grid, it is important that the descriptions show whether the metes and bounds are bearings and distances on the ground, as taken from the grant, survey, or deed records, or grid azimuths and lengths of lines, based upon the State plane-coordinate system.

EXAMPLES OF GEOGRAPHIC AND PLANE COORDINATE POSITIONS

Example No. 1

Geographic Positions

Station	Latitude Longitude	Azimuth	Back Azimuth	To station	Distance (meters)
	° ′ ″	° ′ ″	° ′ ″		
Garden	49 11 09.213	13 27 30.55	193 23 59.92	Miller	24,358.21
	94 52 46.906	78 12 34.23	258 01 05.64	Stoney	18,839.70
Big	49 04 50.694	55 16 09.49	235 05 28.34	Miller	21,013.97
	94 43 16.479	104 44 31.37	284 25 52.06	Stoney	31,022.93
		135 22 46.03	315 15 34.65	Garden	16,445.40

GARDEN (Minnesota, Lake of the Woods County; J. J. McArthur, 1913; 1917). On Lake of the Woods, near the middle of the lake, on Garden Island. The station is about one-third mile from the northwest end of the island and is nearer the north shore than the south shore.
Station mark: A bronze disk set in a concrete block.

BIG (Ontario, Kenora District; C. H. Sinclair, 1913; 1917). On Lake of the Woods, on the southwest point of Big Island. The station is on a bare rock about 3½ meters above the lake level.
Station mark: A bronze disk set in the solid rock.

Example No. 2

Plane Coordinate Positions

A tract of land in Cherokee County, State of North Carolina, described as follows:

Beginning at a concrete monument with bronze tablet marked 472–7 in the Corporation Line of the City of the coordinates of which referred to the North Carolina Coordinate System, are N. 1,470,588 and E. 416,239;

From the initial corner,

N. 5°33' W., 1304 ft., to a TVA monument;
S. 89°19' E., 2664 ft., to a TVA monument;
S. 6°00' E., 1311 ft., to a TVA monument;
N. 89°11' W., 2675 ft., to the point of beginning.

The tract as described contains 79.6 acres.

The position of monuments and direction of lines are referred to the North Carolina Coordinate Syste[illegible]

○

.3. Designation of Leasing Areas. In certain circumstances it is an administrative expediency to delineate land areas known to contain valuable deposits of leasable minerals. When sufficient geologic data is available to determine the existence of a mineral deposit of sufficient quality and quantity to be deemed workable, the area may be delineated and determined to be subject to lease under the provisions of the Mineral Leasing Act of 1920 (41 Stat. 437), and pursuant to authority contained in the Act of March 3, 1879 (43 U.S.C. 31), as supplemented by Reorganization Plan No. 3 of 1950 (5 U.S.C. 481, note), and Secretary's Order No. 2563 (15 F.R. 3193). Such actions serve two administrative purposes: (1) Permit applications will be automatically rejected for any of the lands within the designated area; and (2) the requirement of reserving the rights of the leasable mineral so designated to the United States becomes self evident.

A. Definition. Administratively, the "leasing area" is that area defined by the Director, Geological Survey, in accordance with the provisions of the authority cited above.

Technically, it is that area in which there is direct evidence that the mineral deposit is known or believed to exist in sufficient quantity and of such quality to establish that the deposit is commercially workable and that prospecting is not required to determine these factors.

B. Procedure. Geologists of the Branch of Mineral Classification will assemble all pertinent geologic data and prepare contour and isopach maps and cross sections to determine the extent and thickness of the mineral deposits under review and will collect and analyze mineral samples to determine whether the deposit is of minimum workable quality. Minimum standards that will be applied as to thickness, and which establish the quantity and quality will be those appearing in the approved Standards (Chapter 4.1, Part 611, this Manual).

When the geologic data have been assembled and the quantity and quality established, factors must be considered to determine workability which will then become the deciding factor in the question of competitive leasing versus noncompetitive prospecting permits. The factors that will determine workability are of an economic and engineering nature. This phase of the determination, therefore, is properly assigned to the Branch of Mining Operations. The final product is one of collaboration between the Mineral Classification Geologist and a Professional Engineer of the Branch of Mining Operations.

Department of the Interior
GEOLOGICAL SURVEY
CONSERVATION DIVISION MANUAL

Program Series — Part 671 Inter-Branch Functions

Chapter 4 Known Leasing Areas. (Re revision) — 671.4.1

.1 Designation of Leasing Areas. In accordance with the procedures prescribed in the Branch of Mineral Classification Manual 613.4.3, areas of the public domain may be designated as known leasing areas when there is sufficient geologic data available to determine that a mineral deposit, subject to lease under the Mineral Leasing Act of February 25, 1920, as amended and supplemented, exists in sufficient quantity and quality to be considered workable.

.2 Effect of Designation. The mineral deposits for which lands are designated as leasing areas are not subject to the prospecting permit provisions of the Mineral Leasing Act. They are subject to leasing only.

.3 Action on Applications. Each application for a prospecting permit or for a lease covering lands within a known leasing area will be referred by BLM to the appropriate Regional Mining Supervisor for a report.

A. Report to Bureau of Land Management on Permit Applications. If the application is for a prospecting permit for a deposit on lands that have been designated as a known leasing area, the Supervisor will prepare a report to the appropriate BLM office recommending rejection of the application for the reason that the lands are in an area designated as subject to the leasing provisions of the Act only. The report will be prepared for the signature of the Chief, Conservation Division, "For the Director," and will be surnamed and forwarded to the Chief, Branch of Mining Operations, for review. If the report is satisfactory, the Chief, Branch of Mining Operations, will forward it to the Chief, Conservation Division, for signature, "For the Director."

B. Report to Bureau of Land Management on Lease Applications. If the application is for a lease for the deposit for which the lands have been designated as a known leasing area, the Regional Mining Supervisor will prepare a report to the appropriate BLM office recommending that the lands be leased or not leased, as appropriate. The report will be prepared for the signature of the Chief, Conservation Division, "For the Director." The Regional or District Geologist will be requested to furnish a report, if needed, on the geologic factors that may influence the selection of logical leasing units.

(1) Contents of Report. If the report contains a recommendati that the lands be leased, it will normally include, but not necessarily be limited to, the following recommendatic regarding:

(a) The leasing units in which the lands are to be offere for lease.

(b) Special conditions to be included in the lease.

(c) Royalty provision.

(d) Minimum acceptable bonus bid.

(e) Amount of bond.

(f) Rental rate, when the rental recommended is at a higher rate than the minimum rental prescribed by applicable law or regulations.

(g) Special provisions to be included in the published notice of the lease offer.

The report should also include a statement as to whether the lands involved are considered to be valuable for geothermal resource development. If the report recommends the leasing of lands in addition to those applied for or the exclusion of lands included in the application, the reason for such recommendation should be clearly stated.

(2) Report Forwarded to the Branch of Mining Operations. The completed report should be forwarded to the Chief, Branch of Mining Operations. It should be routed through the Regional or District Geologist for endorsement or comments.

(3) Action by Branch of Mining Operation and Branch of Mineral Classification. The report will be reviewed first in the Branch of Mining Operations and then in the Branch of Mineral Classification and, if satisfactory, will be forwarded to the Chief, Conservation Division, for signature, "For the Director."

.1 Authority. Both the coal and phosphate leasing permit provisions of the Mineral Leasing Act of February 25, 1920, as amended, authorize in identical language the issuance of prospecting permits, "When prospecting or exploratory work is necessary to determine the existence or workability of" coal (30 U.S.C. 201) or phosphate deposits (30 U.S.C. 211). The provisions for sodium (30 U.S.C. 261-263) and potash (30 U.S.C. 281-286) do not specifically authorize the issuance of prospecting permits to determine workability of sodium or potash deposits, but they require discovery of a "valuable deposit" by the permittee. The regulations 43 CFR 3142.2 and 3152.2 provide for the issuance of permits "to prospect and explore the lands involved to determine the existence of, or workability of, "potassium or sodium deposits therein.

.2 Factors to be Considered in Determining Workability.

A. Definition. Neither the Mineral Leasing Act nor the Departmental regulations define the term "workability".

B. Departmental Decisions Pertaining to Workability. The various Departmental decisions involving workability have stated as follows:

(1) The workability of any coal will ultimately be determined by two offsetting factors.

(a) Its character and heat-giving quality, whence comes its value, and

(b) Its accessibility, quantity, thickness, depth and other conditions that affect the cost of its extraction.

It must be considered a workable coal if its value, as determined by its character and heat-giving quality, exceeds the cost of extraction, either as judged by actual experience at the point where it is found or as judged by actual experience on similar coals similarly situated elsewhere. There are no absolute limits to any of the factors. The mining of one-inch of coal that may involve the mining of three feet of rock is physically possible but would not pay. Most unworkable coal beds

lack one or more of three things--quality, thickness, accessibility--that is, they are too poor, too thin, or too deep. Emil Usibelli, A Ben Shallit, A-26277 (October 2, 1951).

(2) The language of the statute is definite and specific--the Secretary is not required, but he is permitted, to issue coal prospecting permits on public lands if prospecting or exploratory work on that land is necessary to determine the existence or workability of coal deposits. It must be interpreted as permitting issuance of a prospecting permit only when the Secretary does not know of the existence or workability of coal deposits.

(3) In making determinations of workability, information received or developed subsequent to the date of applicatio for a prospecting permit is to be considered. If, at the time action is taken on the application for a permit, available information establishes the existence and workability of the coal deposit in the land, a prospecting permit may not be issued. Claude P. Heiner, 70 I.D. 149 (1963).

(4) There is no authority to issue a permit for more detailed exploration on lands where coal deposits are known to exist in workable quantity. Claude P. Heiner, 70 I.D. 149 (1963); Colorado-Ute Electric Association, Inc., A-29964 (February 20, 1964), Roland C. Townsend, A-30142, A-30250 (Sept. 14, 1965).

✳(5) In order to sustain a finding that phosphate deposits exist in workable quantity and quality, it is not necessary that the information specifically describe the phosphate deposit within the lands applied for, where detailed information is available regarding the existence of a workable deposit in adjacent lands and geologic and other surrounding external conditions from which the existence and workability of the deposits in the lands involved can be reasonably inferred. American Nuclear Corporation A-30808 (March 5, 1968).

Coal Prospecting Perm
No longer issued

(6) It is not necessary that such detailed information be available concerning deposits that a determination can be made with some degree of assurance that a mining operation will be an economic success. Sinclair Mines, Inc., A-27160 (August 18, 1955); Morris Kline, A-27651 (October 29, 1958); Colorado-Ute Electric Association, Inc., supra. Also, see Atlas Corporation, 74 I.D. 76 (1967), and American Nuclear Corporation, supra.

(7) It is enough that the available data is sufficient to determine that the lands under consideration would require only limited prospecting to project a program for development, but would not require prospecting for the purpose of determining the presence or workability of the deposit. Atlas Corporation, supra, American Nuclear Corporation, supra.

(8) A coal prospecting permit may not be issued solely in order to determine whether coal in known deposits is suitable for a particular purpose, Virgil V. Peterson, Utah 0144507 (January 17, 1966), for example, to determine the coking qualities of coal, Malcolm N. McKinnon, et al., A-29588 (August 2, 1963), Colorado-Ute Electric Association, Inc., A-29964 (February 20, 1964), or to determine whether deposits are suitable for the intended development of a power plant. K. N. Garard, A-29886 (November 26, 1963); Colorado-Ute Electric Association, Inc., A-29964 (February 20, 1964).

(9) Appropriate information regarding grade, thickness, and continuity is required to determine workability, American Nuclear Corporation, supra.

(10) A prospecting permit may be issued to determine the workability of a coal deposit although known outcrops of coal exist in the lands, Emil Usibelli, A Ben Shallit, A-26277 (October 2, 1951), or the lands adjoin other lands containing known workable deposits of coal, but which themselves are not known to contain coal in workable quantity and thickness. Clarence E. Felix; A-30197 (January 7, 1965).

.3 Procedure. Upon receipt of a request from the Bureau of Land Management for a report on a prospecting permit application, the Regional Mining Supervisor, unless he already has sufficient information as to the existence and workability of the deposits in the lands concerned to recommend rejection of the permit application, will forward a copy of the serial register sheet furnished by the BLM to the appropriate Regional or District Geologist for a geologic report.

A. Action by the District or Regional Geologist. The geologist, upon receipt of a copy of the serial register sheet, should also request, receive and review all pertinent information from the case files of the Re[illegible] for preparation of his report. He should utilize all additional geologic information available from any reliable source. If he decides it necessary, he should also make a spot field investigation. One of the primary purposes of the geologist's review of all geologic data and related factors is to save the time and effort of the Supervisor in searching through geologic literature and in compiling resource data on the area under application. The review will also be of considerable value in the event of an appeal.

(1) It is the responsibility of the geologist

(a) To establish whether or not existence is known;

(b) If existence is known, to provide any additional geologic data of value to assist the Supervisor in making a workability determination; or

(c) If existence is not known, to indicate the minimum exploration requirements likely to be necessary to establish existence.

(2) The geologist is to report his findings to the Supervisor with a copy of his report to the Chief, Branch of Mineral Classification. His report should clearly indicate to the Supervisor whether or not existence is known or not known.

(a) If the existence of the deposit is known, the geologist's report will inform the Supervisor of that fact and will, in addition, include such information as available to assist the Supervisor in making a determination on the workability of the deposit. Such information should include the quantity, thickness, depth, extent, quality and pitch of the deposit on the basis of what is known ~~or can~~ reasonably be inferred. The geologist's report, however, should not include any conclusions as to the workability of the deposit, such as that ~~the~~ lands contain deposits in "workable quantity or quality" or in "commercial quantities".

(b) If existence is not known, the geologist's report to the Supervisor will inform him of this fact and also indicate the minimum exploratory requirements likely to be necessary to establish existence.

B. Workability Determination to be Made by the Regional Mining Supervisor. The Regional Mining Supervisor will determine whether the deposits are subject to competitive leasing or whether prospecting or exploratory work is necessary to determine their workability. In making the determination he will ~~consider~~ the published data, the geologic findings of the Regional or District Geologist and other available data.

C. Report to Bureau of Land Management.

(1) Existence Known but Workability Doubtful. If existence is known, but workability is doubtful and the Regional Mining Supervisor believes that workability can be determined by prospecting and exploring under special stipulations added to the usual provisions of a prospecting permit, he will document his reasons for the record and will prepare a memorandum from the Director, to be signed "For the Director", to the appropriate BLM office recommending that a permit be issued subject to such special stipulations. In this

connection, a "discovery" of a valuable deposit (30 U.S.C. 211(b)) or a deposit of commercial quantities (30 U.S.C. 201(b)), necessary to entitle the permittee to a preference right lease, cannot be merely further proof that the deposit exists. The prospecting and exploration must remove reasonabl doubt concerning the workability of the deposit.

(2) Existence and Workability Established. If the Regional Mining Supervisor believes that the workability of a deposit is established, he will prepare a memorandum from the Director, to be signed "For the Director", to the appropriate office of the BLM containing the Survey's findings and a recommendation that the permit application be rejected. If the Supervisor is of the opinion that the lands should be offered for competitive leasing, the memorandum to BLM will contain a recommendation for competitive leasing by logical leasing units, if practical, and recommendations as to the conditions under which the lands are to be leased as specified in CDM 671.4.3B.

(3) Memorandum Forwarded to the Branch of Mining Operation The proposed memorandum report with a copy of the report received from the Regional or District Geologis will be forwarded to the Chief, Branch of Mining Operations.

(4) Action by Branch of Mining Operations and Branch of Mineral Classification. The report will be reviewed first in the Branch of Mining Operations and then in the Branch of Mineral Classification and, if satisfactory, will be forwarded to the Chief, Conservation Division, for signature "For the Director".

PETER OBERLINDACHER

Department of the Interior

GEOLOGICAL SURVEY - CONSERVATION DIVISION

BRANCH OF MINERAL CLASSIFICATION MANUAL

.1 Public Land. All applications for permits or leases for the minerals subject to lease under the provisions of the Mineral Leasing Acts of February 25, 1920 (41 Stat. 438, as amended), and of February 27, 1927 (44 Stat. 1057, as amended), are filed with the Bureau of Land Manageme These applications, other than oil and gas, are then referred to the Regional Mining Supervisors of the Geological Survey for consideration and report, recommending action thereon (BLM Manual, Vol. VI, 2.4.10A; 2.5.10; 2.6.10; 2.7.10; and 2.9.9) (Geological Survey Manual, Part 621

A. Permits. The granting of permits to prospect for leasable minerals in unclaimed and undeveloped areas to determine the existence or workability of such mineral deposits is authorized under the Acts of February 25, 1920 (41 Stat. 438, as amended), and February 27, 1927 (44 Stat. 1057, as amended), and the governing regulations are found in Parts 191, 193, 194, 195, 196, 197, and 198, 43 CFR. The report of the Regional Mining Supervisor recommending action will provide the Bureau of Land Management with the basis of establishin whether a prospecting permit will be granted or whether the land should be offered for competitive leasing. In the Regional Mining Supervisors' offices located in Denver, Salt Lake City, Carlsbad, Anchorage, and Washington, D. C., the Mining Supervisor will call upon the Regional or District Geologist for a report as to the significant geologic factors bearing upon a determination as to whether the lands are subject to permit or lease. The geologists' responsibility is to furnish geologic data which would establish whether prospecting is necessary to determine if the mineral deposi exists in sufficient quantity and quality to indicate commercial workability. The Regional Mining Supervisor will take these conclusions into account in drafting the report to the Bureau of Land Management and will determine whether the geologic conditions and the economic and engineering factors combined indicate that prospecting is necessary to determine workability. The Regional Geologist will endorse the reports to the Bureau of Land Management if he agrees with its conclusions, otherwise he will submit a repor to the Chief, Branch of Mineral Classification stating the reasons for his dissension. The Regional Mining Supervisor's report is submitted to the Chief, Branch of Mining Operations, and it is referred to the Branch of Mineral Classification for concurrence and endorsement.

The Regional Mining Supervisor at McAlester, Oklahoma, will refer applications for mineral permits to the Regional Geologist at Tulsa, Oklahoma, and the report to the Bureau of Land Management from the Regional Mining Supervisor, Billings, Montana, will be reviewed for consideration of the geologic factors by the Regional Geologist at Great Falls, Montana. The Regional Mining Supervisor at Salt Lake City, Utah, will refer applications for mineral permits to the Regional Geologist at Los Angeles, California on lands within that geologist's region. For other areas not mentioned, the Regional Mining Supervisors will refer their requests to the regional geologists' offices concerned.

Leases. Aside from reporting on a permit application and recommending that the land be subject to lease for the reason that prospecting is not necessary to determine the existence of a mineral deposit, the Mineral Classification Geologist is not concerned with a lease application. However, the Regional Mining Supervisor may call upon the geologist for a report on the geologic factors that may influence the selection of logical leasing units.

Aquired Land. The Act of August 7, 1947 (61 Stat. 913) authorizes the issuance of permits and leases for oil, gas, oil shale, coal, phate, potassium, sodium, and sulfur for land acquired by the ted States subject to the same conditions as in the Act of ruary 25, 1920 (BLM Manual, Vol. VI, 2.4.2A). The governing ulations under the Act cited above are contained in 43 CFR 191, to 200. Section 402, Reorganization Plan No. 3 of 1946 Stat. 1099), authorizes the leasing of minerals other than those ered by the Act of August 7, 1947 (supra), and the governing ulations are contained in 43 CFR 200.31 to 200.51.

pplications, other than for oil and gas, for permits or leases orized by the Acts cited above are filed with the Bureau of Land gement and are referred to the Regional Mining Supervisor of the logical Survey for consideration and report recommending action on. Procedures for reporting and the criteria for differentiating en noncompetitive prospecting permits and competitive leases is me as that prescribed in paragraph .1 of this chapter relating blic Land mineral permits. (See also Geological Survey Manual, 621).

.1 Authority. The Mineral Leasing Act of February 25, 1920, as amended, authorizes a prospecting permittee who (1) shows, that prior to the expiration of his permit, the land included in the permit contains coal in commercial quantities (30 U.S.C. 201), (2) discovers valuable potassium deposits (30 U.S.C. 282), (3) discovers valuable sodium deposits (30 U.S.C. 262), (4) shows to the Secretary that valuable phosphate deposits have been discovered (30 U.S.C. 211), or (5) upon a satisfactory showing that valuable deposits of sulphur have been discovered (30 U.S.C. 272), be issued a preference right lease for all or part of the land embraced in his permit.

.2 Action on Applications. Applications for preference right leases are referred by BLM to the appropriate Regional Mining Supervisor for a report.

A. Procedure. Upon receipt of a request from the Bureau of Land Management for a report on the discovery claimed under the permit, the Regional Mining Supervisor will refer the application to the appropriate Regional or District Geologist for a report together with his case record and any other pertinent information in his files.

(1) Report by the Regional or District Geologist. The Regional or District Geologist will submit a report to the Regional Mining Supervisor advising as to the validity of the geological data supporting the discovery. Inasmuch as the existence (thickness, depth, quality, and extent) of a deposit is fundamental in the determination of a discovery, the report should thoroughly review all these data which have become available through the prospecting by the permittee.

(2) Report by the Regional Mining Supervisor. The Regional Mining Supervisor will review the basis for discovery submitted in the application and the geological report together with all other pertinent engineering data to determine if the discovered deposit is workable (671.5.2) and will prepare a report and his recommendation.

(3) Transmittal of Recommendation. The Regional Mining Supervisor should transmit to the Chief, Branch of Mining Operations, his report, the geological report, and a memorandum to the BLM for signature by the Chief, Conservation Division, "For the Director".

B. Action by Branch of Mining Operations and Branch of Mineral Classification. The reports will be reviewed first in the Branch of Mining Operations and then in the Branch of Mineral Classification and, if satisfactory, will be forwarded to the Chief, Conservation Division, for approval.

(1) Minutes. The factors considered in arriving at a determination of a leasing area shall be recorded as formal minutes prepared in the form prescribed in Exhibit 1. These minutes shall include a complete land description of the area to be included, bear the signature of the geologists and mining engineers involved in the considerations, and then be submitted to the respective Branch Chiefs for acceptance.

(2) Leasing-Area Plats. After the proposed leasing area has been accepted by the respective Branch Chiefs, a plat will be prepared and submitted to the Director for approval. After approval the plats will be reproduced for distribution and unless impracticable shall be 8" x 10½" in size in the form shown in Exhibit 2.

(3) Distribution of Plats. The leasing-area plats will be distributed to the Manager of the appropriate Land Office and to the following offices in accordance with current instructions regarding distribution:

Manager, Land Office for State involved.
Regional Mining Supervisor for States within region.
Regional Geologist for States within region.
District Geologist.
Director, BLM (Minerals Staff Officer).

.4 Designation of Areas Valuable Prospectively. The determination of areas valuable prospectively for leasable minerals is made where geologic data suggest that the mineral may be present meeting classification standards. Positive information on the quality, thickness, and depth of occurrence is lacking principally because of the absence of adequate mapping and developments. To preserve the Government mineral estate and prevent loss of title through nonmineral entries this type of classification is made.

A. Definition. "A valuable prospectively area" is that area defined by the Director, Geological Survey, pursuant to authority contained in the Act of March 3, 1879 (43 U.S.C. 31), as supplemented by Reorganization Plan No. 3 of 1950 (5 U.S.C. 481, note), and Secretary's Order No. 2563 (15 F.R. 3193).

This determination is applied to either withdrawn areas or areas not withdrawn but containing Federal lands.

B. State base maps showing areas of lands valuable prospectively for leasable minerals will be maintained.

C. Procedure. Geologists of the Branch of Mineral Classification will assemble all pertinent geologic data to determine the extent of the mineral deposit under consideration. From available maps, cross sections, and other information they will prepare minutes justifying the area or areas so designated.

(1) Minutes. The geologic factors considered in determining the prospective area shall be recorded as formal minutes prepared in the form prescribed in Exhibit 1. These minutes shall include a complete land description of the area to be included, bear the signatures of the geologists involved, and then be submitted to the Chief of the Branch for review and approval.

(2) Prospective Area Maps and Plats. After the proposed valuable prospectively area or areas have been accepted by the Branch Chief, a plat or map will be prepared and submitted to the Director for approval. After approval the map or plats will be reproduced for distribution. Unless infeasible, the plats shall be 8" x 10½" in size in the form shown in Exhibit 2.

(3) Distribution of Maps and Plats. The prospective area maps or plats will be distributed only to the offices of the Division concerned.

Procedure for Acquisition and Development of Minerals Subject to the Mineral Leasing Act of 1920, as Amended, and the Acquired Lands Act of August 7, 1947 (including National Forest Lands).

STEP I — Applicant files mineral prospecting permit application with Bureau of Land Management, accompanied by $10 filing fee and first year's rental at 25¢ per acre or fraction thereof.

STEP II — Bureau of Land Management adjudicates application lands which are presently under mineral permit or lease to others. Land presently under other ownership is rejected from application.

STEP III — Bureau of Land Management furnishes copy of application with copy of serial register page with letter of request to U.S. Geological Survey for report and recommendation on the lands applied for. If other than BLM surface administration, other surface agency receives material similar to that sent USGS with request for action.

STEP IV (a) — U.S. Geological Survey, by memorandum, requests intra-agency geologic report. Geological Survey also requests surface clearance report for archaeological and endangered species (flora and fauna) purposes from surface agency or recognized authority or U.S. Fish and Wildlife Service.

STEP IV (b) — Following review of geologic report; numerous publications; personal knowledge of the area; geologic and other information available from terminated, cancelled or otherwise relinquished adjacent or nearby permits and/or leases, the Mining Supervisor drafts a report and makes recommendations (favorable or unfavorable) to the State Director, BLM, over the signature of the Regional Conservation Manager who has authority to sign "For the Director."

Bureau of Land Management "Officer" may call for Joint "Technical Exam" of lands by affected Government agency personnel.

STEP IV (c) — Review and concurrence or non-concurrence of the recommendations by the Regional Conservation Manager. Report and recommendation (if approved) is signed and sent to State Director, BLM.

STEP V — Bureau of Land Management incorporates U.S. Geological Survey recommendation with review of recommendations received from other agencies having surface jurisdiction. BLM notifies applicant of rejection or acceptance of application and makes permit offer subject to stipulations, including bonding requirements.

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STEP V — Bureau of Land Management incorporates U.S. Geological Survey recommendation with review of recommendations received from other agencies having surface jurisdiction. BLM notifies applicant of rejection or acceptance of application and makes permit offer subject to stipulations, including bonding requirements.

STEP VI — After acceptance of permit, permittee files an exploration proposal with USGS, showing the location of proposed exploration sites (drill pads, trench locations, drill depths, etc.), and how access to the sites is anticipated. Surface administering agency personnel with USGS participation examine lands to determine and mitigate potential environmental hazards. Approve or recommend changes in proposal are made by USGS directly to permittee.

STEP VII — With submission of data required by ~~30~~ 43 CFR 231 regulations, permittee files application with BLM. For "Preference Right Lease" — Title 43 part 3520 — on any or all of the lands held under permit. At request of BLM, USGS evaluates data submitted by permittee to acknowledge whether or not a valid discovery has been made. If data shows affirmatively that a valuable discovery has been made, recommendations to BLM are so noted. Additionally, stipulations, including bonding requirements, reclamation, royalty rate, and other conditions are passed to permittee through BLM. Potential lessee is afforded an opportunity to peruse the terms and conditions of the lease offer. If found acceptable, applicant signs lease form and returns same to BLM for signature.

STEP VIII — Lease issues. Lessee is now bound by regulations in all matters related to the lease.

STEP IX — If lessee is interested in bringing property into production, the next step in a continuing procedure is the submission of a mine plan proposal. By law and regulation, the U.S. Geological Survey is required to evaluate all proposals which involve surface disturbances by drafting a document in the form of an Environmental Assessment (EA). A similar document is prepared by the surface administering agency, resulting in that agency's stipulations evaluated and/or included in the USGS EA. If it is determined from the EA that sufficient disturbance may result from the proposed action, a statement to that effect is made and a recommendation for the drafting of a full environmental impact statement is undertaken.

STEP X — If all parties involved in the lease (private and all levels of Government) are satisfied that all conditions can be met without environmental degradation, the mining plan can be approved and mining commenced.

Classification of Public Lands Valuable for Geothermal Steam anc Associated Geothermal Resources

By L.H. GODWIN, L.B. HAIGLER, R.L. RIOUX,
D.E. WHITE, L.J.P. MUFFLER, and R.G. WAYLAND

GEOLOGICAL SURVEY CIRCULAR 647

Standards used by the Geological Survey to classify public lands for retention and for competitive leasing of geothermal steam and associated geothermal resources

Washington 1971

CONTENTS

	Page
Abstract	1
Introduction	1
Nature of geothermal resources	6
Present state of geothermal knowledge	6
Classification factors for retention	7
Classification factors for a known geothermal resources area	8
Classification factors—Continued	
Geology (including geophysical and geochemical data)	
Nearby discoveries	
Competitive interests	
Other indicia	
References cited	
Appendix—Geothermal Steam Act of 1970	

ILLUSTRATIONS

Page

FIGURE 1. Map of Alaska showing lands classified for geothermal resources effective December 24, 1970..
2. Map of the Western United States showing lands classified for geothermal resources effective December 24, 1970

TABLE

Page

TABLE 1. Known geothermal resources areas

Classification of Public Lands Valuable for Geothermal Steam and Associated Geothermal Resources

By L. H. Godwin, L. B. Haigler, R. L. Rioux, D. E. White, L. J. P. Muffler, and R. G. Wayland

ABSTRACT

The Organic Act of 1879 (43 U.S.C. 31) that established the U.S. Geological Survey provided, among other things, for the classification of the public lands and for the examination of the geological structure, mineral resources, and products of the national domain. In order to provide uniform executive action in classifying public lands, standards for determining which lands are valuable for mineral resources, for example, leasable mineral lands, or for other products are prepared by the U.S. Geological Survey. This report presents the classification standards for determining which Federal lands are classifiable as geothermal steam and associated geothermal resources lands under the Geothermal Steam Act of 1970 (84 Stat. 1566).

The concept of a geothermal resources province is established for classification of lands for the purpose of retention in Federal ownership of rights to geothermal resources upon disposal of Federal lands. A geothermal resources province is defined as an area in which higher than normal temperatures are likely to occur with depth and in which there is a reasonable possibility of finding reservoir rocks that will yield steam or heated fluids to wells.

The determination of a "known geothermal resources area" is made after careful evaluation of the available geologic, geochemical, and geophysical data and any evidence derived from nearby discoveries, competitive interests, and other indicia. The initial classification required by the Geothermal Steam Act of 1970 is presented.

INTRODUCTION

The Organic Act of 1879 (43 U.S.C. 31) that established the U.S. Geological Survey provided, among other things, for the classification of the public lands and for the examination of the geological structure, mineral resources, and other products of the national domain. With the enactment of the Geothermal Steam Act of 1970, that authority and responsibility now includes, without limitation, to the same extent as in classifying lands under the mineral leasing laws, the authority and responsibility to classify lands as valuable for geothermal steam and associated geothermal resources. Land is so classified in order to reserve or retain those substances in Federal ownership and to determine for the Department of the Interior which lands are included within "known geothermal resources areas" and thus subject to the competitive leasing provisions of the Geothermal Steam Act of 1970 (84 Stat. 1566).

The Geothermal Steam Act of 1970 (see "Appendix"), effective December 24, 1970, includes the following provisions:

SEC. 2(e). "known geothermal resources area" means an area in which the geology, nearby discoveries, competitive interests, or other indicia would, in the opinion of the Secretary, engender a belief in men who are experienced in the subject matter that the prospects for extraction of geothermal steam or associated geothermal resources are good enough to warrant expenditures of money for that purpose.

SEC. 4. If lands to be leased under this Act are within any known geothermal resources area, they shall be leased to the highest responsible qualified bidder by competitive bidding under regulations formulated by the Secretary. If the lands to be leased are not within any known geothermal resources area, the qualified person first making application for the lease shall be entitled to a lease of such lands without competitive bidding. * * *

SEC. 21(a). Within one hundred and twenty days after the effective date of this Act, the Secretary shall cause to be published in the Federal Register a determination of all lands which were included within any known geothermal resources area on the effective date of the Act. He shall likewise publish in the Federal Register from time to time his determination of other known geothermal resources areas specifying in each case the date the lands were included in such area;

SEC. 25. As to any land subject to geothermal leasing under section 3 of this Act, all laws which either (a) provide for the disposal of land by patent or other form of conveyance or by grant or by operation of law subject to a reservation of any mineral or (b) prevent or restrict the disposal of such land because of the mineral character of the land, shall hereafter be deemed to embrace geothermal steam and associated geothermal resources as a substance which either *must be reserved* or *must prevent* or *restrict the disposal of such land*, as the case may be. [Italics added.] This section shall not be construed to affect grants, patents, or other forms of conveyances made prior to the date of enactment of this Act.

In order to assure uniform executive action in the classification of leasable mineral lands in the public domain, standards for determining which lands are mineral lands have been prepared from time to time by the U.S. Geological Survey. It is the duty of the Geological Survey to use geologic expertise to identify those Federal lands that are underlain by or have a reasonable expectation of containing mineral deposits or other products that meet or exceed the minimum limits set by the cla fication standards. Field examination an study of subsurface, geophysical, and chemical data may precede classification. S ilarly, all known pertinent geologic facts considered in determining which legal su visions of lands are classified as geother steam and associated resources lands.

The purpose of this report is to present classification standards that have been es lished to implement the Geothermal Steam of 1970. Figures 1 and 2 show those a which include, in part, Federal lands classi as known geothermal resources areas that be leased only competitively to the hig qualified bidder and those lands classified valuable prospectively for the purpose of tention of geothermal rights in Federal ow ship upon disposal of the lands. Table 1 the known geothermal resources areas effec December 24, 1970.

TABLE 1.—*Known geothermal resources areas*

[Number corresponds to location shown in fig. 1 or 2. Detailed land descriptions of these areas have been published in the "Federal later," v. 36, p. 5626, March 25, 1971; v. 36, p. 6118, April 2, 1971; v. 36, p. 6441, April 3, 1971; v. 36, p. 7319, April 17, 197 v. 36, p. 7759, April 24, 1971]

Locality	Name
	Alaska
1	Pilgrim Springs
2	Geyser Spring Basin and Okmok Caldera
	California
1	The Geysers
2	Salton Sea
3	Mono-Long Valley
4	Calistoga
5	Lake City
6	Wendel-Amedee
7	Coso Hot Springs
8	Lassen
9	Glass Mountain
10	Sespe Hot Springs
11	Heber
12	Brawley
13	Dunes
14	Glamis
	Idaho
1	Yellowstone
2	Frazier
	Montana
1	Yellowstone
	Nevada
1	Beowawe
2	Fly Ranch
3	Leach Hot Springs
	Nevada—Continued
4	Steamboat Springs
5	Brady Hot Springs
6	Stillwater-Soda Lake
7	Darrough Hot Springs
8	Gerlach
9	Moana Springs
10	Double Hot Springs
11	Wabuska
12	Monte Neva
13	Elko Hot Springs
	New Mexico
1	Baca Location No. 1
	Oregon
1	Breitenbush Hot Springs
2	Crump Geyser
3	Vale Hot Springs
4	Mount Hood
5	Lakeview
6	Carey Hot Springs
7	Klamath Falls
	Utah
1	Crater Springs
2	Roosevelt
	Washington
1	Mount St. Helens

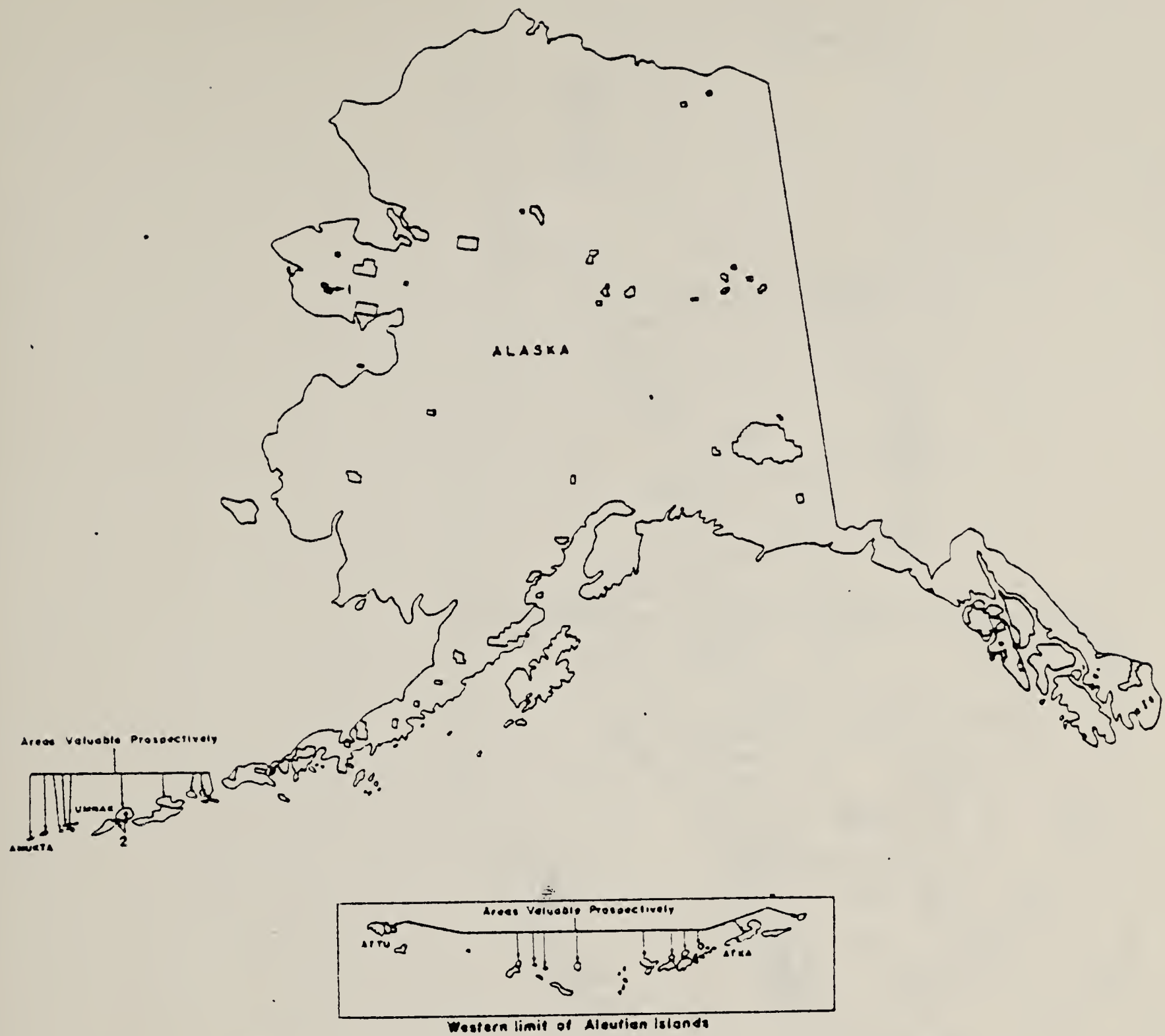


FIGURE 1.—Map of Alaska showing lands classified for geothermal resources effective December 24, 1970. Numbers correspond to areas listed in table 1.

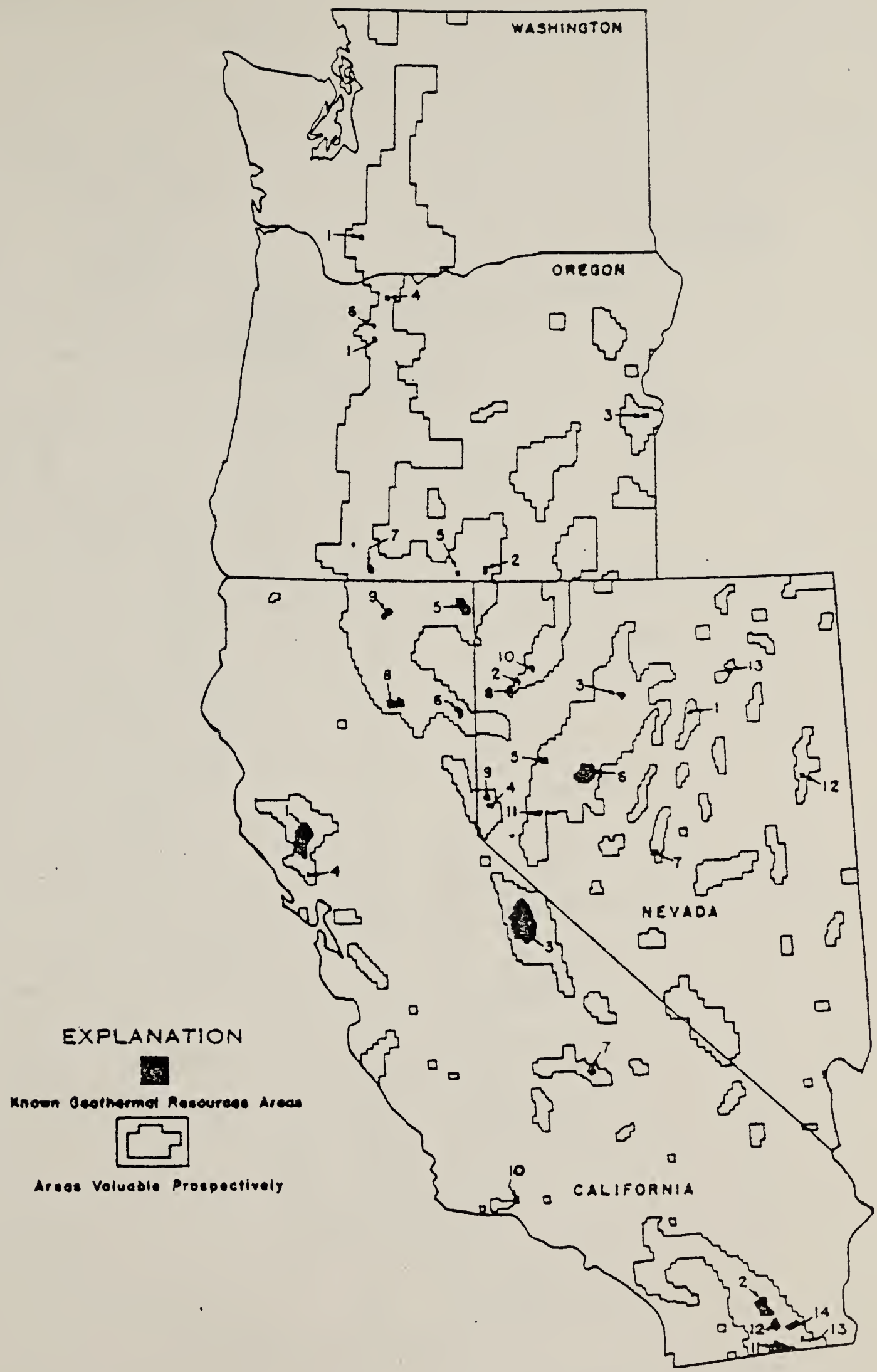
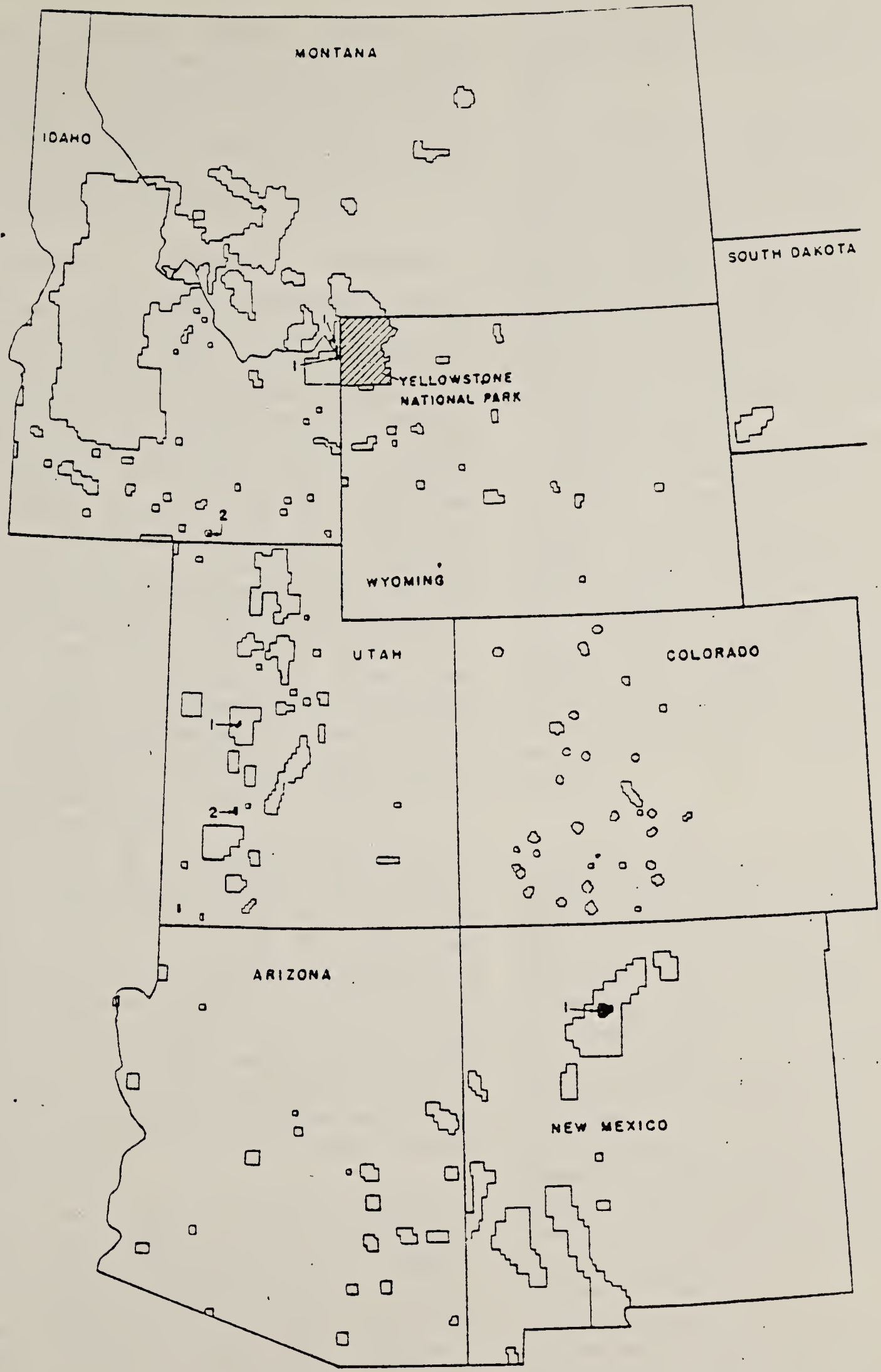


FIGURE 2.—Map of the Western United States showing lands classified for geothermal



resources effective December 24, 1970. Numbers correspond to areas listed in table 1.

Several Geological Survey personnel contributed helpful suggestions in critical reviews during the preparation of this report; and their assistance is gratefully acknowledged. The review and suggestions made by John F. Hughes, Office of the Solicitor, concerning the classification standards were especially useful.

NATURE OF GEOTHERMAL RESOURCES

The earth is an immense reservoir of energy, but most of this energy is contained in the earth's core and mantle at depths unlikely ever to be tapped by any foreseeable drilling technology. Within the earth at depths potentially accessible to drilling (about 6 miles) are stored approximately 10^{24} British thermal units of heat (White, 1965, p. 2), but most of this heat is far too diffuse to be considered as a potential resource. However, economically significant concentrations of geothermal energy do occur in local "hot spots" where high temperatures (150° to 650°F) are found in porous rocks containing liquid water and (or) steam; such concentrations of extractable heat are known as "geothermal reservoirs." The reservoirs are found in regions of recent volcanism and mountain-building and in the deep parts of many sedimentary basins.

The energy in a geothermal reservoir consists of heat, largely stored in rocks and to a lesser extent in liquid water and (or) steam-filling pores and fractures. The water and steam provide the means by which heat from deep sources is transferred by convection to depths shallow enough to be tapped by drilling. Water and steam also serve as the agents by which geothermal heat escapes at the surface in hot springs and fumaroles and through which geothermal heat can be tapped commercially by wells.

The fluid in most geothermal reservoirs is liquid water (White and others, 1971) that is held at temperatures above surface boiling by the confining pressure. Decrease in pressure upon withdrawal of the liquid water causes steam to form by boiling, and a mixture of steam and water is produced at the surface. A few reservoirs contain primarily steam, and the wells produce dry or superheated steam with no water. These dry steam reservoirs are positively known only in the Larderello-M Amiata region of Italy and at The Geyse Calif.

For a geothermal reservoir to have appre able potential for exploitation, it must m the following requirements: (1) relatively hi temperature (greater than 150° to 400°F, pending on processing technology), (2) a dep shallow enough to permit drilling (curren 10,000 ft or less), (3) sufficient rock perm ability to allow the heat transfer agent (wa and (or) steam) to flow continuously at a hi rate, and (4) sufficient water recharge to ma tain production over many years.

Limited exploitation of geothermal reso ces has occurred since the turn of the centu primarily to generate electric power. Geoth mal resources also have been used for spa heating, product processing, and agricultu heating, and in addition some geothermal flu contain chemicals and metals that are pot tially valuable byproducts. Furthermore, g thermal energy appears to have an import potential use in desalination, either of the g thermal fluid itself or of other saline wat that may occur near a source of geother energy.

PRESENT STATE OF GEOTHERMAL KNOWLEI

Geothermal areas exist throughout the wo primarily along the belts of young volcan that ring the Pacific Ocean and that follow midoceanic ridges. Geothermal areas of United States are found primarily in the W ern States, along the circum-Pacific belt young volcanism and mountain-building where the Pacific ridge system (a locus of h heat flow) intersects the North American c tinent along the Gulf of California and Imperial-Coachella Valley of California. In Eastern United States, potentially econo reservoirs of geothermal heat have been i tified in the deep parts of the Gulf of Me sedimentary basin.

The distribution, extent, and magnitude the geothermal resources of the United St are, at present, poorly known. The general tent of the resource in the Western States be inferred from the distribution of hot spri and in a more general way from the distri

tion of young volcanic rocks. In the past, geothermal exploration was primarily on sites identified by hot springs (an exploration method analogous to the primitive oil exploration methods of the turn of the century when oil fields could be located only by finding surface oil seeps). Available geologic and geochemical techniques have not been used adequately in discovering and evaluating new fields, and geophysical principles and techniques are only now beginning to be adapted to geothermal exploration.

Knowledge of the characteristics and parameters of individual geothermal systems in the United States has come from exploratory drilling in about 40 hot-spring areas (J. B. Koenig, "Geothermal Exploration in the Western United States": Paper II/19, United Nations Symposium on the Development and Utilization of Geothermal Resources, Pisa, Italy, September 1970), from developmental drilling (mainly at The Geysers of northern California and the Salton Sea in southern California), and from scientific studies of a few major thermal-spring areas, supplemented by shallow research drilling. Extrapolation of knowledge from other countries, mainly New Zealand, Italy, and Iceland, has proven useful, but techniques for estimating the size and power potential of geothermal sites prior to drilling are only beginning to be developed. Techniques for efficiently utilizing all the energy produced from geothermal wells (that is, by desalination or by two-phase generation) are only beginning to be investigated and developed.

CLASSIFICATION FACTORS FOR RETENTION

The petroleum province is an established concept in classification of oil and gas lands for purposes of retention of Federal mineral rights upon disposal of public lands. A geothermal resources province (GRP) similar in concept to a petroleum province is necessary to define those areas valuable prospectively for geothermal steam and associated geothermal resources.

A geothermal resources province is an area in which higher than normal temperatures are likely to occur with depth and there is a reasonable possibility of finding reservoir rocks that will yield steam or heated fluids to wells. In most prospective areas, data on geothermal gradients and conductive heat flow are scarce. Adequate temperature-depth data exist only in sedimentary basins that have been extensively explored for oil and gas. Most of these basins are characterized by nearly "normal" geothermal gradients rather than the abnormally high rates needed for development of geothermal energy.

The present-day use of geothermal energy includes generation of electricity, manufacturing, agriculture, and space heating. The minimum present-day use for geothermal resources is the exploitation of stored heat energy for space heating. Geothermal fluids used for space heating are generally delivered at above 100°F and are available at the surface or at shallow depths below the surface. S. S. Einarsson ("Utilization of Low Enthalpy Water for Space Heating, Industrial, Agricultural and Other Uses": Rapporteur rept., Sec. X, United Nations Symposium on the Development and Utilization of Geothermal Resources, Pisa, Italy, September 1970) reported use of 118°F water in space heating in Olafsfjordhur, Iceland, and 104°F water in Japan. S. H. Ross ("Geothermal Potential of Idaho": Paper II/1, United Nations Symposium on the Development and Utilization of Geothermal Resources, Pisa, Italy, September 1970) reported use of 104°F water for agricultural purposes in Idaho. Because a heat exchanger can extract the heat from the geothermal fluid, the chemical composition or the corrosiveness of the fluid is not necessarily a controlling factor in classification.

The classification of geothermal resources provinces is based on geologic inference similar to that used by the Geological Survey in classifying lands for retention of oil and gas mineral rights and should provide adequate protection against alienation of leasable geothermal resources. One or more of the following indicia are necessary for the retention classification of lands in geothermal resources provinces:

1. Volcanism of late Tertiary or Quaternary age—especially caldera structures, cones, and volcanic vents.
2. Geysers, fumaroles, mud volcanoes, or thermal springs at least 40°F higher than

average ambient temperature.

3. Subsurface geothermal gradients generally in excess of two times normal, as reflected in deep water wells, oil well tests, and other test holes.

CLASSIFICATION FACTORS FOR A KNOWN GEOTHERMAL RESOURCES AREA

Lands shall be classified as a "known geothermal resources area" (KGRA) when "the prospects for extraction of geothermal steam or associated geothermal resources from an area are good enough to warrant expenditures of money for that purpose." The accumulation of geothermal resources is in some ways similar to the accumulation of oil and gas resources, and only a test hole can establish with certainty the existence of adequate temperatures, pressures, and production capacity of an area. However, the definition of a "known geothermal resources area" departs from the concept of a "known geologic structure of a producing oil or gas field" (Finley, 1959) in that it does *not* require a producible well. Thus, any relevant data and information pertaining to the criteria enumerated in sec. 2(e) of the Geothermal Steam Act can be considered in determining whether lands are included within any KGRA.

The extent of a KGRA is influenced by such geologic factors as the pattern of temperature gradient, structure, stratigraphy, porosity, conductivity, permeability, heat source, and rate of recharge of fluids. The determination of a KGRA is made after evaluating the net effect of all geologic, geochemical, and geophysical data and any evidence derived from nearby discoveries, competitive interests, and other indicia.

GEOLOGY (INCLUDING GEOPHYSICAL AND GEOCHEMICAL DATA)

The following kinds of data, considered together, indicate that the prospects for extraction of geothermal steam or associated geothermal resources are good enough to warrant expenditures of money for that purpose:

1. Siliceous sinter and natural geysers both imply high subsurface temperatures, generally 350°F or greater (D. E. White, "Geochemistry Applied to the Discovery, Evaluation and Exploitation of G thermal Energy Resources": Rapporte rept., Sec. V, United Nations Symposi on the Development and Utilization Geothermal Resources, Pisa, Italy, Se tember 1970) in hot-water systems, cause of relationships generally existi between temperature and SiO_2 content liquid water.
2. The temperatures of fumaroles, thern springs, and mud volcanoes provide mi mum subsurface temperatures.
3. The SiO_2 content of spring water is a ve useful chemical geothermometer for in cating the reservoir temperatures of ma hot-water systems (R. O. Fournier a A. H. Truesdell, "Chemical Indicators Subsurface Temperature Applied to F Spring Waters of Yellowstone Natio Park, Wyoming, U.S.A.": Paper V United Nations Symposium on the Dev opment and Utilization of Geothermal F sources, Pisa, Italy, September 197 D. E. White, see above).
4. The Na/K ratio in spring waters of ma hot-water systems is also a useful che ical geothermometer when there is a quate knowledge of competing influen (D. E. White, see above).
5. Most known potential geothermal syste occur in or near volcanoes and calde of late Tertiary or Quaternary age.
6. Abnormally high conductive heat flow a the geothermal gradient are the best dicators of deep, concealed geotherm reservoirs. Although specific limits ha not yet been established, two to 10 tim the world-wide average (heat flow of microcalories per cm^2 per second; te perature gradient of 1°F per 100 ft) tended consistently over hundreds of f of depth appears favorable.
7. The porosity and the permeability of a tential reservoir are important para eters but can be established only by dr ing and testing. Where stratigraphic c trol of the reservoir fluid or steam b caprock is expected, near-surface ch acteristics of the rocks may provide p liminary evaluations.
8. Electrical resistivity surveys are probab

the best geophysical means to geothermal evaluation available at this time, especially for the hot-water systems.

9. Magnetic, gravity, and airborne infrared geophysical surveys may provide useful suplemental data.
10. Other geophysical methods such as microseismic, seismic ground noise, electromagnetic, and telluric surveys may have significant future use in evaluation.

NEARBY DISCOVERIES

In classifying land as a KGRA, the discovery of a deposit of geothermal steam or associated geothermal resources in the vicinity of such lands is evaluated together with the available data concerning the other criteria enumerated in sec. 2(e) of the Act which are to be considered in classification action.

COMPETITIVE INTERESTS

Competitive interest is considered together with the available data concerning the other criteria enumerated in sec. 2(e) of the Act in classifying lands as being within a KGRA.

Available information which could be considered in determining the existence of competitive interest in connection with an application for a geothermal lease would include information concerning the existence of bona fide, allowable applications for geothermal leases which have been filed for all or any part of the lands sought under the application being considered, or for lands in the vicinity of the lands being sought. The circumstance that two or more "companies" are exploring, applying for, or actually leasing available State or fee lands for geothermal resources in the same general area might constitute competitive interest that would affect Federal lands considered valuable prospectively for geothermal resources and could warrant its classification as a KGRA. The absence of indicated competitive interest, however, is, in and of itself, no bar to classification of lands for inclusion in a KGRA and would not be sufficient to warrant revocation of a KGRA.

OTHER INDICIA

Any pertinent engineering and (or) economic data may be considered together with other available data relating to the criteria enumerated in sec. 2(e) of the Geothermal Steam Act in classifying land for inclusion in a KGRA.

In defining the lands valuable for geothermal resource development under the proposed withdrawal published in the "Federal Register," v. 32, p. 4506, March 24, 1967, the Director of the Geological Survey used primarily a combination of the then known geologic and geophysical data as well as temperature and chemical data, in part supplied by industry, from areas that had been drilled in exploration for geothermal steam. Future developments will provide substantially more geologic and geophysical information as well as engineering and economic data. These factors will be considered in future determinations of KGRA's.

REFERENCES CITED

Finley, E. A., 1959, The definition of known geologic structures of producing oil and gas fields: U.S. Geol. Survey Circ. 419, 6 p.

White, D. E., 1965, Geothermal energy: U.S. Geol. Survey Circ. 519, 17 p.

White, D. E., Muffler, L. J. P., and Truesdell, A. H., 1971, Vapor-dominated hydrothermal systems, compared with hot-water systems: Econ. Geology, v. 66, no. 1, p. 75-97.

Public Law 91-581
91st Congress, S. 368
December 24, 1970

An Act

To authorize the Secretary of the Interior to make disposition of geothermal steam and associated geothermal resources, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That this Act may be cited as the "Geothermal Steam Act of 1970". Geothermal Steam Act of 1970.

Definitions.

SEC. 2. As used in this Act, the term—

(a) "Secretary" means the Secretary of the Interior;

(b) "geothermal lease" means a lease issued under authority of this Act;

(c) "geothermal steam and associated geothermal resources" means (i) all products of geothermal processes, embracing indigenous steam, hot water and hot brines; (ii) steam and other gases, hot water and hot brines resulting from water, gas, or other fluids artificially introduced into geothermal formations; (iii) heat or other associated energy found in geothermal formations; and (iv) any byproduct derived from them;

(d) "byproduct" means any mineral or minerals (exclusive of oil, hydrocarbon gas, and helium) which are found in solution or in association with geothermal steam and which have a value of less than 75 per centum of the value of the geothermal steam or are not, because of quantity, quality, or technical difficulties in extraction and production, of sufficient value to warrant extraction and production by themselves;

(e) "known geothermal resources area" means an area in which the geology, nearby discoveries, competitive interests, or other indicia would, in the opinion of the Secretary, engender a belief in men who are experienced in the subject matter that the prospects for extraction of geothermal steam or associated geothermal resources are good enough to warrant expenditures of money for that purpose.

Leases.

SEC. 3. Subject to the provisions of section 15 of this Act, the Secretary of the Interior may issue leases for the development and utilization of geothermal steam and associated geothermal resources (1) in lands administered by him, including public, withdrawn, and acquired lands, (2) in any national forest or other lands administered by the Department of Agriculture through the Forest Service, including public, withdrawn, and acquired lands, and (3) in lands which have been conveyed by the United States subject to a reservation to the United States of the geothermal steam and associated geothermal resources therein.

Bids.

SEC. 4. If lands to be leased under this Act are within any known geothermal resources area, they shall be leased to the highest responsible qualified bidder by competitive bidding under regulations formulated by the Secretary. If the lands to be leased are not within any known geothermal resources area, the qualified person first making application for the lease shall be entitled to a lease of such lands without competitive bidding. Notwithstanding the foregoing, at any time within one hundred and eighty days following the effective date of this Act:

Conversion.

(a) with respect to all lands which were on September 7, 1965, subject to valid leases or permits issued under the Mineral Leasing Act of February 25, 1920, as amended (30 U.S.C. 181 et seq.), or under the Mineral Leasing Act of Acquired Lands, as amended (30 U.S.C. 351, 358), or to existing mining claims located on or prior to September 7, 1965, the lessees or permittees or claimants or their successors in interest who are qualified to hold geothermal

41 Stat. 437.

61 Stat. 913.

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leases shall have the right to convert such leases or permits or claims to geothermal leases covering the same lands;

(b) where there are conflicting claims, leases, or permits therefor embracing the same land, the person who first was issued a lease or permit, or who first recorded the mining claim shall be entitled to first consideration;

(c) with respect to all lands which were on September 7, 1965, the subject of applications for leases or permits under the above Acts, the applicants may convert their applications to applications for geothermal leases having priorities dating from the time of filing of such applications under such Acts;

Acreage limitation.

(d) no person shall be permitted to convert mineral leases, permits, applications therefor, or mining claims for more than 10,240 acres; and

(e) the conversion of leases, permits, and mining claims and applications for leases and permits shall be accomplished in accordance with regulations prescribed by the Secretary. No right to conversion to a geothermal lease shall accrue to any person under this section unless such person shows to the reasonable satisfaction of the Secretary that substantial expenditures for the exploration, development, or production of geothermal steam have been made by the applicant who is seeking conversion, on the lands for which a lease is sought or on adjoining, adjacent, or nearby Federal or non-Federal lands.

(f) with respect to lands within any known geothermal resources area and which are subject to a right to conversion to a geothermal lease, such lands shall be leased by competitive bidding: *Provided*, That, the competitive geothermal lease shall be issued to the person owning the right to conversion to a geothermal lease if he makes payment of an amount equal to the highest bona fide bid for the competitive geothermal lease, plus the rental for the first year, within thirty days after he receives written notice from the Secretary of the amount of the highest bid.

Lease provisions.

SEC. 5. Geothermal leases shall provide for—

Royalties.

(a) a royalty of not less than 10 per centum or more than 15 per centum of the amount or value of steam, or any other form of heat or energy derived from production under the lease and sold or utilized by the lessee or reasonably susceptible to sale or utilization by the lessee;

(b) a royalty of not more than 5 per centum of the value of any byproduct derived from production under the lease and sold or utilized or reasonably susceptible of sale or utilization by the lessee, except that as to any byproduct which is a mineral named in section 1 of the Mineral Leasing Act of February 25, 1920, as amended (30 U.S.C. 181), the rate of royalty for such mineral shall be the same as that provided in that Act and the maximum rate of royalty for such mineral shall not exceed the maximum royalty applicable under that Act;

41 Stat. 437.

Rent.

(c) payment in advance of an annual rental of not less than $1 per acre or fraction thereof for each year of the lease. If there is no well on the leased lands capable of producing geothermal resources in commercial quantities, the failure to pay rental on or before the anniversary date shall terminate the lease by operation of law: *Provided, however*, That whenever the Secretary discovers that the rental payment due under a lease is paid timely but the amount of the payment is deficient because of an error or other reason and the deficiency is nominal, as determined by the Secretary pursuant to regulations prescribed by him, he shall notify the lessee of the deficiency and such lease shall not automatically terminate unless

the lessee fails to pay the deficiency within the period prescribed in the notice: *Provided further*, That, where any lease has been terminated automatically by operation of law under this section for failure to pay rental timely and it is shown to the satisfaction of the Secretary of the Interior that the failure to pay timely the lease rental was justifiable or not due to a lack of reasonable diligence, he in his judgment may reinstate the lease if—

(1) a petition for reinstatement, together with the required rental, is filed with the Secretary of the Interior; and

(2) no valid lease has been issued affecting any of the lands in the terminated lease prior to the filing of the petition for reinstatement; and

(d) a minimum royalty of $2 per acre or fraction thereof in lieu of rental payable at the expiration of each lease year for each producing lease, commencing with the lease year beginning on or after the commencement of production in commercial quantities. For the purpose of determining royalties hereunder the value of any geothermal steam and byproduct used by the lessee and not sold and reasonably susceptible of sale shall be determined by the Secretary, who shall take into consideration the cost of exploration and production and the economic value of the resource in terms of its ultimate utilization.

Term.

SEC. 6. (a) Geothermal leases shall be for a primary term of ten years. If geothermal steam is produced or utilized in commercial quantities within this term, such lease shall continue for so long thereafter as geothermal steam is produced or utilized in commercial quantities, but such continuation shall not exceed an additional forty years.

Limitation.

Renewal.

(b) If, at the end of such forty years, steam is produced or utilized in commercial quantities and the lands are not needed for other purposes, the lessee shall have a preferential right to a renewal of such lease for a second forty-year term in accordance with such terms and conditions as the Secretary deems appropriate.

Extension.

(c) Any lease for land on which, or for which under an approved cooperative or unit plan of development or operation, actual drilling operations were commenced prior to the end of its primary term and are being diligently prosecuted at that time shall be extended for five years and so long thereafter, but not more than thirty-five years, as geothermal steam is produced or utilized in commercial quantities. If, at the end of such extended term, steam is being produced or utilized in commercial quantities and the lands are not needed for other purposes, the lessee shall have a preferential right to a renewal of such lease for a second term in accordance with such terms and conditions as the Secretary deems appropriate.

(d) For purposes of subsection (a) of this section, production or utilization of geothermal steam in commercial quantities shall be deemed to include the completion of one or more wells producing or capable of producing geothermal steam in commercial quantities and a bona fide sale of such geothermal steam for delivery to or utilization by a facility or facilities not yet installed but scheduled for installation not later than fifteen years from the date of commencement of the primary term of the lease.

(e) Leases which have extended by reasons of production, or which have produced geothermal steam, and have been determined by the Secretary to be incapable of further commercial production and utilization of geothermal steam may be further extended for a period of not more than five years from the date of such determination but only for so long as one or more valuable byproducts are produced in commercial quantities. If such byproducts are leasable under the Mineral Leasing Act of February 25, 1920, as amended (30 U.S.C. 181, et seq.), or under the Mineral Leasing Act for Acquired Lands (30 U.S.C.

41 Stat. 437.

61 Stat. 913.

351–358), and the leasehold is primarily valuable for the production thereof, the lessee shall be entitled to convert his geothermal lease to a mineral lease under, and subject to all the terms and conditions of, such appropriate Act upon application at any time before expiration of the lease extension by reason of byproduct production. The lessee shall be entitled to locate under the mining laws all minerals which are not leasable and which would constitute a byproduct if commercial production or utilization of geothermal steam continued. The lessee in order to acquire the rights herein granted him shall complete the location of mineral claims within ninety days after the termination of the lease for geothermal steam. Any such converted lease or the surface of any mining claim located for geothermal byproducts mineral affecting lands withdrawn or acquired in aid of a function of a Federal department or agency, including the Department of the Interior, shall be subject to such additional terms and conditions as may be prescribed by such department or agency with respect to the additional operations or effects resulting from such conversion upon adequate utilization of the lands for the purpose for which they are administered.

(f) Minerals locatable under the mining laws of the United States in lands subject to a geothermal lease issued under the provisions of this Act which are not associated with the geothermal steam and associated geothermal resources of such lands as defined in section 2(c) herein shall be locatable under said mining laws in accordance with the principles of the Multiple Mineral Development Act (68 Stat. 708; found in 30 U.S.C. 521 et seq.).

Leases, acreage.

SEC. 7. A geothermal lease shall embrace a reasonably compact area of not more than two thousand five hundred and sixty acres, except where a departure therefrom is occasioned by an irregular subdivision or subdivisions. No person, association, or corporation, except as otherwise provided in this Act, shall take, hold, own, or control at one time, whether acquired directly from the Secretary under this Act or otherwise, any direct or indirect interest in Federal geothermal leases in any one State exceeding twenty thousand four hundred and eighty acres, including leases acquired under the provisions of section 4 of this Act.

Limitation.

Increase.

At any time after fifteen years from the effective date of this Act the Secretary, after public hearings, may increase this maximum holding in any one State by regulation, not to exceed fifty-one thousand two hundred acres.

Readjustment.

SEC. 8. (a) The Secretary may readjust the terms and conditions, except as otherwise provided herein, of any geothermal lease issued under this Act at not less than ten-year intervals beginning ten years after the date the geothermal steam is produced, as determined by the Secretary. Each geothermal lease issued under this Act shall provide for such readjustment. The Secretary shall give notice of any proposed readjustment of terms and conditions, and, unless the lessee files with the Secretary objection to the proposed terms or relinquishes the lease within thirty days after receipt of such notice, the lessee shall conclusively be deemed to have agreed with such terms and conditions. If the lessee files objections, and no agreement can be reached between the Secretary and the lessee within a period of not less than sixty days, the lease may be terminated by either party.

Notice.

(b) The Secretary may readjust the rentals and royalties of any geothermal lease issued under this Act at not less than twenty-year intervals beginning thirty-five years after the date geothermal steam is produced, as determined by the Secretary. In the event of any such readjustment neither the rental nor royalty may be increased by more than 50 per centum over the rental or royalty paid during the preceding period, and in no event shall the royalty payable exceed 22½ per centum. Each geothermal lease issue under this Act shall provide

for such readjustment. The Secretary shall give notice of any proposed readjustment of rentals and royalties, and, unless the lessee files with the Secretary objection to the proposed rentals and royalties or relinquishes the lease within thirty days after receipt of such notice, the lessee shall conclusively be deemed to have agreed with such terms and conditions. If the lessee files objections, and no agreement can be reached between the Secretary and the lessee within a period of not less than sixty days, the lease may be terminated by either party. Notice.

(c) Any readjustment of the terms and conditions as to use, protection, or restoration of the surface of any lease of lands withdrawn or acquired in aid of a function of a Federal department or agency other than the Department of the Interior may be made only upon notice to, and with the approval of, such department or agency.

Byproducts.

SEC. 9. If the production, use, or conversion of geothermal steam is susceptible of producing a valuable byproduct or byproducts, including commercially demineralized water for beneficial uses in accordance with applicable State water laws, the Secretary shall require substantial beneficial production or use thereof unless, in individual circumstances he modifies or waives this requirement in the interest of conservation of natural resources or for other reasons satisfactory to him. However, the production or use of such byproducts shall be subject to the rights of the holders of preexisting leases, claims, or permits covering the same land or the same minerals, if any.

Relinquishment.

SEC. 10. The holder of any geothermal lease at any time may make and file in the appropriate land office a written relinquishment of all rights under such lease or of any legal subdivision of the area covered by such lease. Such relinquishment shall be effective as of the date of its filing. Thereupon the lessee shall be released of all obligations thereafter accruing under said lease with respect to the lands relinquished, but no such relinquishment shall release such lessee, or his surety or bond, from any liability for breach of any obligation of the lease, other than an obligation to drill, accrued at the date of the relinquishment, or from the continued obligation, in accordance with the applicable lease terms and regulations, (1) to make payment of all accrued rentals and royalties, (2) to place all wells on the relinquished lands in condition for suspension or abandonment, and (3) to protect or restore substantially the surface and surface resources.

Suspension.

SEC. 11. The Secretary, upon application by the lessee, may authorize the lessee to suspend operations and production on a producing lease and he may, on his own motion, in the interest of conservation suspend operations on any lease but in either case he may extend the lease term for the period of any suspension, and he may waive, suspend, or reduce the rental or royalty required in such lease.

Leases, termination. Notice.

SEC. 12. Leases may be terminated by the Secretary for any violation of the regulations or lease terms after thirty days notice provided that such violation is not corrected within the notice period, or in the event the violation is such that it cannot be corrected within the notice period then provided that lessee has not commenced in good faith within said notice period to correct such violation and thereafter to proceed diligently to correct such violation. Lessee shall be entitled to a hearing on the matter of such claimed violation or proposed termination of lease if request for a hearing is made to the Secretary within the thirty-day period after notice. The period for correction of violation or commencement to correct such violation of regulations or of lease terms, as aforesaid, shall be extended to thirty days after the Secretary's decision after such hearing if the Secretary shall find that a violation exists.

SEC. 13. The Secretary may waive, suspend, or reduce the rental or royalty for any lease or portion thereof in the interests of conservation and to encourage the greatest ultimate recovery of geothermal

resources, if he determines that this is necessary to promote development or that the lease cannot be successfully operated under the lease terms.

Surface land, use.

SEC. 14. Subject to the other provisions of this Act, a lessee shall be entitled to use so much of the surface of the land covered by his geothermal lease as may be found by the Secretary to be necessary for the production, utilization, and conservation of geothermal resources.

SEC. 15. (a) Geothermal leases for lands withdrawn or acquired in aid of functions of the Department of the Interior may be issued only under such terms and conditions as the Secretary may prescribe to insure adequate utilization of the lands for the purposes for which they were withdrawn or acquired.

(b) Geothermal leases for lands withdrawn or acquired in aid of functions of the Department of Agriculture may be issued only with the consent of, and subject to such terms and conditions as may be prescribed by, the head of that Department to insure adequate utilization of the lands for the purposes for which they were withdrawn or acquired. Geothermal leases for lands to which section 24 of the Federal Power Act, as amended (16 U.S.C. 818), is applicable, may be issued only with the consent of, and subject to, such terms and conditions as the Federal Power Commission may prescribe to insure adequate utilization of such lands for power and related purposes.

41 Stat. 1075; 62 Stat. 275.

(c) Geothermal leases under this Act shall not be issued for lands administered in accordance with (1) the Act of August 25, 1916 (39 Stat. 535), as amended or supplemented, (2) for lands within a national recreation area, (3) for lands in a fish hatchery administered by the Secretary, wildlife refuge, wildlife range, game range, wildlife management area, waterfowl production area, or for lands acquired or reserved for the protection and conservation of fish and wildlife that are threatened with extinction, (4) for tribally or individually owned Indian trust or restricted lands, within or without the boundaries of Indian reservations.

16 USC 1.

Lessees, citizenship requirement.

SEC. 16. Leases under this Act may be issued only to citizens of the United States, associations of such citizens, corporations organized under the laws of the United States or of any State or the District of Columbia, or governmental units, including, without limitation, municipalities.

SEC. 17. Administration of this Act shall be under the principles of multiple use of lands and resources, and geothermal leases shall, insofar as feasible, allow for coexistence of other leases of the same lands for deposits of minerals under the laws applicable to them, for the location and production of claims under the mining laws, and for other uses of the areas covered by them. Operations under such other leases or for such other uses, however, shall not unreasonably interfere with or endanger operations under any lease issued pursuant to this Act, nor shall operations under leases so issued unreasonably interfere with or endanger operations under any lease, license, claim, or permit issued pursuant to the provisions of any other Act.

Cooperative or unit plan.

SEC. 18. For the purpose of properly conserving the natural resources of any geothermal pool, field, or like area, or any part thereof, lessees thereof and their representatives may unite with each other, or jointly or separately with others, in collectively adopting and operating under a cooperative or unit plan of development or operation of such pool, field, or like area, or any part thereof, whenever this is determined and certified by the Secretary to be necessary or advisable in the public interest. The Secretary may in his discretion and with the consent of the holders of leases involved, establish, alter, change, revoke, and make such regulations with reference to such leases in connection with the institution and operation of any such cooperative or unit plan as he may deem necessary or proper to secure reasonable protection of the

public interest. He may include in geothermal leases a provision requiring the lessee to operate under such a reasonable cooperative or unit plan, and he may prescribe such a plan under which such lessee shall operate, which shall adequately protect the rights of all parties in interest, including the United States. Any such plan may, in the discretion of the Secretary, provide for vesting in the Secretary or any other person, committee, or Federal or State agency designated therein, authority to alter or modify from time to time the rate of prospecting and development and the quantity and rate of production under such plan. All leases operated under any such plan approved or prescribed by the Secretary shall be excepted in determining holdings or control for the purposes of section 7 of this Act.

When separate tracts cannot be independently developed and operated in conformity with an established well-spacing or development program, any lease, or a portion thereof, may be pooled with other lands, whether or not owned by the United States, under a communitization or drilling agreement providing for an apportionment of production or royalties among the separate tracts of land comprising the drilling or spacing unit when determined by the Secretary to be in the public interest, and operations or production pursuant to such an agreement shall be deemed to be operations or production as to each lease committed thereto.

The Secretary is hereby authorized, on such conditions as he may prescribe, to approve operating, drilling, or development contracts made by one or more lessees of geothermal leases, with one or more persons, associations, or corporations whenever, in his discretion, the conservation of natural products or the public convenience or necessity may require or the interests of the United States may be best served thereby. All leases operated under such approved operating, drilling, or development contracts, and interests thereunder, shall be excepted in determining holdings or control under section 7 of this Act.

SEC. 19. Upon request of the Secretary, other Federal departments and agencies shall furnish him with any relevant data then in their possession or knowledge concerning or having bearing upon fair and adequate charges to be made for geothermal steam produced or to be produced for conversion to electric power or other purposes. Data given to any department or agency as confidential under law shall not be furnished in any fashion which identifies or tends to identify the business entity whose activities are the subject of such data or the person or persons who furnished such information.

Moneys.

SEC. 20. All moneys received under this Act from public lands under the jurisdiction of the Secretary shall be disposed of in the same manner as moneys received from the sale of public lands. Moneys received under this Act from other lands shall be disposed of in the same manner as other receipts from such lands.

Publication in Federal Register

SEC. 21. (a) Within one hundred and twenty days after the effective date of this Act, the Secretary shall cause to be published in the Federal Register a determination of all lands which were included within any known geothermal resources area on the effective date of the Act. He shall likewise publish in the Federal Register from time to time his determination of other known geothermal resources areas specifying in each case the date the lands were included in such area; and

(b) Geothermal resources in lands the surface of which has passed from Federal ownership but in which the minerals have been reserved to the United States shall not be developed or produced except under geothermal leases made pursuant to this Act. If the Secretary of the Interior finds that such development is imminent, or that production from a well heretofore drilled on such lands is imminent, he shall so report to the Attorney General, and the Attorney General is authorized

and directed to institute an appropriate proceeding in the United States district court of the district in which such lands are located, to quiet the title of the United States in such resources, and if the court determines that the reservation of minerals to the United States in the lands involved included the geothermal resources, to enjoin their production otherwise than under the terms of this Act: *Provided*, That upon an authoritative judicial determination that Federal mineral reservation does not include geothermal steam and associated geothermal resources the duties of the Secretary of the Interior to report and of the Attorney General to institute proceedings, as hereinbefore set forth, shall cease.

SEC. 22. Nothing in this Act shall constitute an express or implied claim or denial on the part of the Federal Government as to its exemption from State water laws.

Waste, prevention.

SEC. 23. (a) All leases under this Act shall be subject to the condition that the lessee will, in conducting his exploration, development, and producing operations, use all reasonable precautions to prevent waste of geothermal steam and associated geothermal resources developed in the lands leased.

(b) Rights to develop and utilize geothermal steam and associated geothermal resources underlying lands owned by the United States may be acquired solely in accordance with the provisions of this Act.

Rules and regulations.

SEC. 24. The Secretary shall prescribe such rules and regulations as he may deem appropriate to carry out the provisions of this Act. Such regulations may include, without limitation, provisions for (a) the prevention of waste, (b) development and conservation of geothermal and other natural resources, (c) the protection of the public interest, (d) assignment, segregation, extension of terms, relinquishment of leases, development contracts, unitization, pooling, and drilling agreements, (e) compensatory royalty agreements, suspension of operations or production, and suspension or reduction of rentals or royalties, (f) the filing of surety bonds to assure compliance with the terms of the lease and to protect surface use and resources, (g) use of the surface by a lessee of the lands embraced in his lease, (h) the maintenance by the lessee of an active development program, and (i) protection of water quality and other environmental qualities.

SEC. 25. As to any land subject to geothermal leasing under section 3 of this Act, all laws which either (a) provide for the disposal of land by patent or other form of conveyance or by grant or by operation of law subject to a reservation of any mineral or (b) prevent or restrict the disposal of such land because of the mineral character of the land, shall hereafter be deemed to embrace geothermal steam and associated geothermal resources as a substance which either must be reserved or must prevent or restrict the disposal of such land, as the case may be. This section shall not be construed to affect grants, patents, or other forms of conveyances made prior to the date of enactment of this Act.

Disposal of lands

30 USC 530.

SEC. 26. The first two clauses in section 11 of the Act of August 13, 1954 (68 Stat. 708, 716), are amended to read as follows:

"As used in this Act, 'mineral leasing laws' shall mean the Act of February 25, 1920 (41 Stat. 437); the Act of April 17, 1926 (44 Stat. 301); the Act of February 7, 1927 (44 Stat. 1057); Geothermal Steam Act of 1970, and all Acts heretofore or hereafter enacted which are amendatory of or supplementary to any of the foregoing Acts; 'Leasing Act minerals' shall mean all minerals which, upon the effective date of this Act, are provided in the mineral leasing laws to be disposed of thereunder and all geothermal steam and associated geothermal resources which, upon the effective date of the Geothermal Steam Act of 1970, are provided in that Act to be disposed of thereunder;".

30 USC 181.
30 USC 281.

Certain mineral rights, retention by U. S.

SEC. 27. The United States reserves the ownership of and the right to extract under such rules and regulations as the Secretary may prescribe oil, hydrocarbon gas, and helium from all geothermal steam and associated geothermal resources produced from lands leased under this Act in accordance with presently applicable laws: *Provided*, That whenever the right to extract oil, hydrocarbon gas, and helium from geothermal steam and associated geothermal resources produced from such lands is exercised pursuant to this section, it shall be exercised so as to cause no substantial interference with the production of geothermal steam and associated geothermal resources from such lands.

Approved December 24, 1970.

LEGISLATIVE HISTORY:

HOUSE REPORT No. 91-1544 (Comm. on Interior and Insular Affairs).
SENATE REPORT No. 91-1160 (Comm. on Interior and Insular Affairs).
CONGRESSIONAL RECORD, Vol. 116 (1970):
Sept. 16, Oct. 14, Dec. 4, 10, considered and passed Senate.
Oct. 5, Dec. 9, considered and passed House.

GPO 915-883

UNITED STATES
DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY
Conservation Division
345 Middlefield Road
Menlo Park, California 94025

May 14, 1974

Memorandum

To: State Director, Bureau of Land Management, Portland, Oregon

From: Acting Conservation Manager, Western Region

Subject: Procedures for handling geothermal lease applications

Your memo of April 24, 1974, 3200(943.1) transmitting a copy of Instruction memo No. ORE-74-134 is appreciated.

The interim procedures appear quite straight forward and should help to establish a routine in this new and untried program. Our comments and suggestions following are intended to be in a constructive vein as we work together in an attempt to comply with the intent of the Geothermal Steam Act, the regulations, and Secretarial Order No. 2948.

The procedure on advising your office as to whether any of the lands in geothermal lease applications are within KGRA's is still open for discussion. We would appreciate your comments or reaction on the following procedure:

1. As soon as possible after receiving formal notification from your office as to the competitive interest KGRA's created by overlaps of 50% or more (section 1. of your instruction memo No. ORE-74-134), we plan to notify you as to whether any additional lands in the area of the competitive interest KGRA's have been determined to be in a KGRA. Our memos of May 2, 1974 notified you of the first three areas: Vale Hot Springs KGRA, Belknap-Foley Hot Springs KGRA, and McCredie Hot Springs KGRA.

2. As the District Manager's or the Forest Service indicate that consideration will be given to leasing in an area of geothermal lease applications, we furnish an initial KGRA report upon request and receipt of a copy of the lease applications.

3. After the lease forms are prepared, incorporating any necessary stipulations, we request that we receive a copy of the lease, before it is sent to the lessee for signature, bond, etc. This would serve two

functions: (1) an updata on the KGRA status since there will be a considerable time interval after any initial KGRA report and (2) a review of any special lease stipulations for concurrence or further discussion before lease execution.

4. The final KGRA report will be furnished in accordance with Section 5. of your I.M. ORE-74-134.

The initial KGRA report on individual lease applications as discussed in step 2. above may be unnecessary in view of our planned action under step 1. above. The probability of additional KGRA's being established in areas outside of those considered as in step 1. above, in the absence of drilling and a geothermal discovery, is quite low. This would eliminate one "back-and-forth" action. May we have your comments on this possibility?

We request that you or your District Manager's advise us when an EAR is planned for a particular area of lease applications. This will enable us to keep abreast of the progress, work with the DM's on the EAR's as requested, and to discuss any proposed special stipulations as they are being considered. This will maximize the probability of any proposed stipulations being agreeable to both BLM and GS, thus avoiding prolonged review of the stipulations in step 3. discussed above.

Your reactions to our comments and requests would be appreciated. Further discussions may be in order and we will be glad to meet with you or your staff to clarify any of the particulars.

Hillary A. Oden

cc: Mel Suchy, Division of Lands and Minerals,F.S., Portland (w/enclosures)
Cons. Mgr., Central Region (w/enclosure)
Area Geologist, Pacific Area (w/enclosure)
Cons. Mgr.,Western Region (w/enclosure)

HAO/med

RECEIVED
U.S. Geological Survey
APR 29 1974
Conservation Division
Western Region
Menlo Park, Calif.

IN REPLY REFER TO:

United States Department of the Interior

3200 (943.1)

BUREAU OF LAND MANAGEMENT

OREGON STATE OFFICE
P.O. Box 2965 (729 N.E. Oregon Street)
Portland, Oregon 97208

APR 24 1974

Memorandum

To: Mr. Hillary A. Oden
Assistant Conservation Manager
Conservation Division
U.S. Geological Survey
345 Middlefield Road
Menlo Park, California 94025

From: State Director, Oregon

Subject: Applications for Geothermal Leases

Enclosed is a copy of Instruction Memo No. ORE-74-134 setting forth interim procedures for handling geothermal applications filed for lands in Oregon and Washington. There are a number of references in it to the role of USGS. We will appreciate your comments and suggestions.

There may be minor revisions, but for the most part, we believe, these procedures should facilitate the handling of geothermal lease applications.

Richie D. Croft

Enclosure:
Instruction Memo No. ORE-74-134

IN REPLY REFER TO:

United States Department of the Interior

3200 (943.1)

BUREAU OF LAND MANAGEMENT

OREGON STATE OFFICE
P.O. Box 2965 (729 N.E. Oregon Street)
Portland, Oregon 97208

MAR 29 1974

Instruction Memo No. ORE-74-134
Expires 12/31/74

To: All District Managers

From: State Director, Oregon

Subject: Processing Noncompetitive Geothermal Lease Applications

Pending issuance of formal manual releases, the following are the procedures under which we will operate as to geothermal leasing:

1. As soon as possible after the opening of the applications received during a filing period, the Competitive Interest KGRA's created by overlaps of 50% or more will be identified. See 43 CFR 3200.0-5(k)(3). When these are determined, the adjudication officer will notify the appropriate DM, and/or the FS. He will also furnish notice to the Land Records Section, for noting the Geothermal Plat(s). Applications filed during the same filing period (or later one) for lands in these KGRA's will be rejected as to such lands.

2. As soon as possible after the first working day of each month, copies of the serial pages for the previous month's geothermal applications will be sent to [illegible], the district(s) involved, and/or the FS. Within 30 days the DM or FS will inform the State Director (943.1) as to whether they intend to recommend, or consent, to issuance of a lease (subject to appropriate stipulations) all else being regular. (The stipulations will not need to be specified at this stage.)

Ordinarily an on-the-ground examination will not be necessary yet, as this preliminary estimate can usually be made by checking planning maps, etc., to ascertain whether there is any conflict with either an established or planned project. If such conflict exists, your recommendation for rejection of the application should be supported with adequate reasons.

Meanwhile the [illegible] will report to the SD as to whether or not any of the lands are in KGRA's.

3. If the DM or FS report indicates that consideration will be given to leasing, we will require the applicant to furnish his proposed or preliminary plan of operation. See 43 CFR 3210.2-1(d). The plan will usually be quite simple, but should facilitate your preparation of the EAR. (If no plan is furnished, the application will be rejected.)

4. Upon receipt of the plan, we will send one copy to and a copy to the DM and/or FS, for an EAR and recommendations as to special stipulations for protection of the surface, etc. (As a result of your analysis or study under NEPA, you might conclude that a lease should not be issued. Such a determination must be supported with adequate facts etc., to enable us to take the appropriate action.)

5. After receipt of a favorable report from the DM or FS (together with recommendations as to stipulations, surface bond requirements, etc.) and input as to rental, stipulations, etc., we will prepare the lease forms, incorporating the stipulations, and send them to the applicant for signature, bond, and other requirements. If applicant does not sign and return the forms and meet other requirements within the time allowed (usually 30 days), the application will be finally rejected and the case closed.

If applicant signs and returns the lease forms, and meets other requirements timely, we will request the final KGRA report from If reports that the lands are not within a KGRA, the lease will be signed by the authorized officer of BLM, and dated in accordance with 43 CFR 3203.1-1. A copy of the lease will be forwarded to and to the DM and/or FS.

5. If the final report from shows that any or all of the lands are in a KGRA, the application will be rejected to that extent, and the KGRA lands will be offered later for competitive bidding, in accordance with 43 CFR 3220.

Acting D. Crapo

Distribution
FS (2810) Portland, Attn: Zean Moore - 2
Menlo Park, CA, Attn: Hillary Oden
WO-412 - 2
DSC-D-700 - 4

United States Department of the Interior

GEOLOGICAL SURVEY
WASHINGTON, D.C. 20242

JUN 13 1974
RECEIVED
JUN 1 3 1974
Conservation Division
U.S. GEOLOGICAL SURVEY
Office of the Area Geologist
Menlo Park, California

Memorandum

To: Regional Managers
Area Geothermal Supervisor
Area Geologists

From: Chief, Conservation Division

Subject: Definition of KGRA's

Recently several memoranda sent to the State Director's, Bureau of Land Management, have contained the term "undefined KGRA". This subject was discussed at the recent Manager's conference in Menlo Park and it was decided that the term "undefined KGRA" is not appropriate. No distinction is made between "competitive interest" KGRA's and other KGRA's in the Geothermal regulations; competitive interest is merely one of the criteria which defines a KGRA. Therefore, the terms "undefined" or "competitive interest" KGRA should be avoided in the future.

The identification of a KGRA changes the status of Federal land from "subject to non-competitive leasing" to "subject only to competitive leasing provisions of the Geothermal Steam Act". Minutes of the Mineral Land Evaluation Committee should be prepared for all KGRA's. The minutes should be concise, yet sufficiently detailed to adequately support the determination of the KGRA. Since the minutes are available for public inspection, data not subject to public disclosure should be omitted. The Area Geologist should prepare the minutes in accordance with Exhibit 1 part 613, Chapter 4 of the Former Branch of Mineral Classification Manual (enclosed).

Please note the following items in the minutes preparation procedures:

1. The Area Geothermal Supervisor should be in consultation.
2. The Area Geologist should sign as chairman of the committee.
3. Review should be by the Staff of the Regional Conservation Manager.
4. Approval will be by the Regional Conservation Manager.
5. A page size plat should be prepared in accordance with Exhibit 2, Part 613, Chapter 4 Conservation Division Manual, except Regional Manager will be substituted for the Director.

After the Regional Manager has approved a KGRA, he shall inform the appropriate State Director, Bureau of Land Management, by memorandum that the KGRA is in effect, transmitting a plat and land description. The memo to the State Director should follow the enclosed sample format.

One copy of the KGRA minutes, with page size plat, should be forwarded to the Chief, Conservation Division (attention: ADC-Resource Evaluation, Mail Stop 640) for review for conformity to Division policy. The Regional Manager shall also forward the Federal Register Notice of KGRA's to the Chief, Conservation Division for review and forwarding to the Federal Register for publication. Please refer to my memorandum of May 18, 1974: "Delegated Authority---and to publish notice of such determinations in the Federal Register" for guidance in preparing the Notice. Several KGRA's may be included in one Notice.

The appropriate Area Geologist should prepare the minutes, the memorandum to the State Director, and the Federal Register Notice: simultaneously transmitting the package to the Regional Manager for his approval and signature and a copy to the Area Geothermal Supervisor for his information.

Chief, Conservation Division

Enclosure

United States Department of the Interior

GEOLOGICAL SURVEY
WASHINGTON, D.C. 20242

Memorandum

To: State Director, Bureau of Land Management
(City, State)

From: Conservation Manager, (Region)
U. S. Geological Survey, (City, State)

Subject: Definition of the (_____) KGRA, (State) or
addition to the (_____) KGRA, (State)

In accordance with Section 2(e) of the Geothermal Steam Act of 1970 (Public Law 91-581) and 43 CFR 3200.0-5, the following described lands have been determined to be within the (_____) (or addition to the (_____)) Known Geothermal Resources Area, effective (date).

Sample: Salt Lake Meridian, Utah
T. 26 S., R. 9 W.
Secs. 15 through 17, 20 through 24,
26 through 32, 35 inclusive

T. 27 S., R. 9 W.
Secs. 1, 2, 5 through 8, 11, 14,
17 through 23, 25 through 29,
35, 36 inclusive

Containing 24,596.05 acres, more or less

Federal lands may be affected by this determination. We will publish notice of the action in the Federal Register as appropriate.

Conservation Manager
(Region)

Enclosure

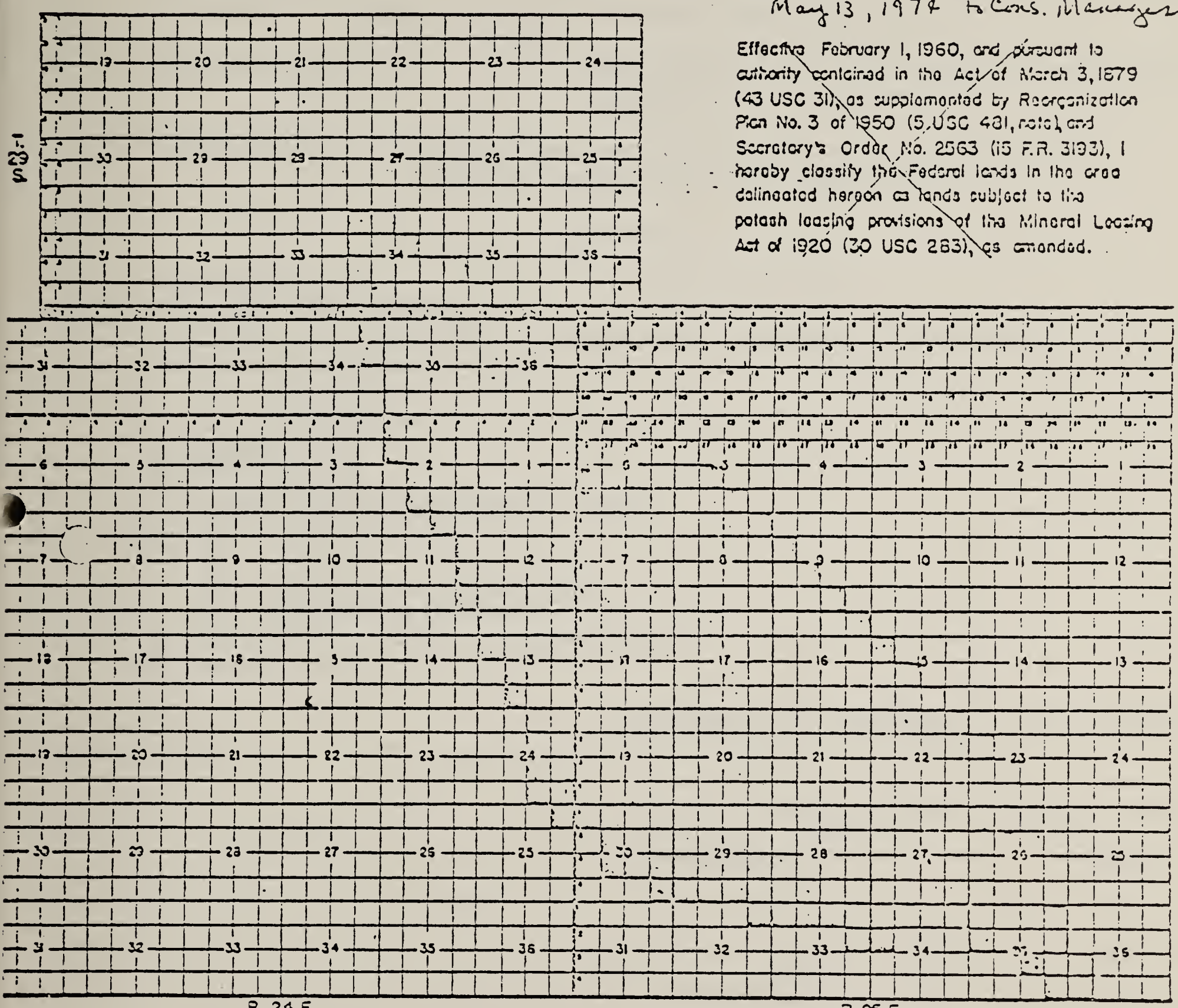
KNOWN GEO [illegible]
Prot. U.S., Circ. [illegible]

LISBON VALLEY ~~POTASH~~ AREA

Ts. 29-29½ S., R. 24 E., T. 30 S., Rs. 24-25 E., S.L.M., Utah

See memo from Chief CD dated May 13, 1974 to Cons. Managers.

Effective February 1, 1960, and pursuant to authority contained in the Act of March 3, 1879 (43 USC 31), as supplemented by Reorganization Plan No. 3 of 1950 (5 USC 481, note), and Secretary's Order No. 2563 (15 F.R. 3193), I hereby classify the Federal lands in the area delineated hereon as lands subject to the potash leasing provisions of the Mineral Leasing Act of 1920 (30 USC 283), as amended.



Total area subject to lease (completive)

16,178 acres

Cons. Manager
~~ACTING DIRECTOR~~
U. S. Geological Survey

May 18, 1960

File: ....(State)....Known Geothermal Resources Area Minutes No. 1

Minutes of the Mineral Land Evaluation Committee

Date:

Subject: ....(name) ....Known Geothermal Resources Area

Minutes Prepared by: (Name geologist(s) and geothermal engineer(s) preparing and reviewing data.)

In consultation: (Include Geothermal Supervisor, geologist(s) and/or geothermal engineer(s) participating.)

(Outline)

1. Introduction
2. Legal Considerations.
3. History of ...mineral... Exploration, Discovery and Development.
4. General Factors.
   A. Location
   B. Physiography
5. Stratigraphy
6. Structure
7. Description of geothermal indicia
8. Basis for Evaluation
   A. Geologic
   B. Economic and Engineering
   C. Competitive interest
9. Description of Land in Leasing Area
10. References

Submitted and recommended by the Committee:

_____

(Geologist) 2/ Member

_____

(Geologist) 2/ Member

_____

(Area Geologist) Chairman

Reviewed by: _____ Date: _____
Staff Geologist (Managers staff)

....(State)... ....Known Geothermal Resources Area Minutes No._____

(Last page should have some text in addition to signatures)

Approved by:

_____ _____

Conservation Manager Date

1/ This number will be supplied by the Conservation Manager's office in a numerical series separate from the classification minutes series.

2/ Geologists and Geothermal Engineers as shown under Classification Committee Present.

Distribution: Original for Washington office.

File: (State) Known Geothermal Resources Area Minutes No. ____

Minutes of the Mineral Land Evaluation Committee

Date:

Subject: (Name) Known Geothermal Resources Area, (county, state)

Evaluation Committee Present:

In Consultation:

Introduction

Legal Considerations

Geographic Setting

Rock Units

File: (State) Known Geothermal Resources Area Minutes No. ____

Structure

History of Significant Exploration and Development

Description of Geothermal Indicia

Basis for Evaluation

File: (State) Known Geothermal Resources Area Minutes No. _____

Description of Land

File: (State) Known Geothermal Resources Area Minutes No. _____

References

Submitted and recommended by the Committee

Minutes prepared
By:

_____
Member

_____
Chairman

Reviewed by: _____ Date: _____
Designated Geologist

Approved by:

_____ _____
Conservation Manager Date

AUG 2 7 1974

Memorandum

To: Conservation Manager, Central Region

From: Chief, Conservation Division

Subject: Comments on KGRA Minutes Submitted to Headquarters for Review

The enclosed KGRA's that were received on August 2, 1974, are being returned to you for minor corrections. Also enclosed for your information is a copy of the format that is to be followed in writing future KGRA minutes. The notice of KGRA determinations was forwarded on August 14, 1974, to the Federal Register for publication. Please correct our copy and return it as time permits.

The following errors were noted in the minutes:

1. Near the top of the first page, the classification committee present should be "evaluation committee present".
2. The Geothermal Supervisor should have been included under "In consultation".
3. Members of the committee that were indicated on the first page were not the signers of the minutes.
4. The Area Geologist did not sign the minutes as chairman of the committee.
5. The minutes were not signed by a reviewer on the Manager's staff.
6. On the fifth line of the paragraph about the authority on the plat, the number 1565 shown should be 1566 instead.

Russell G. Wayland

Chief, Conservation Division

Enclosures

cc: ✓CD File — Chief, ESP Section, Denver
ADC/RE — Area Geologist, Denver
ROSchrott — Area Geologist, Casper
REchron. — Area Geologist, Roswell
Area Geologist, Tulsa
✓Geothermal Supervisor

ROSchrott/LHGodwin:jef 8-15-74

Comments on other area KGRAs.

RECEIVED
AUG 30 1974
Conservation Division
U.S. GEOLOGICAL SURVEY
Menlo Park, California

UNITED STATES
DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY
Conservation Division
345 Middlefield Road
Menlo Park, California 94025

September 25, 1974

Memorandum

To: Area Geothermal Supervisor, Western Area
Area Geologist, Pacific Area
Area Geologist, Alaska Area

RECEIVED
SEP 24 1974
Conservation Division
U.S. GEOLOGICAL SURVEY
Office of the Area Geologist
Menlo Park, California

From: Conservation Manager, Western Region

Subject: Geothermal Lease Sale Procedures

The following procedures are to be implemented for future geothermal lease sales in the Western Region.

1. Lease Sale Committee. The Lease Sale Committee will be responsible for providing recommendations on tract selection and parcelling and for the lease sale evaluation. The Committee shall be composed of at least three members. At least one member will be designated by the appropriate Area Geologist and at least two members by the Western Area Geothermal Supervisor. The Chief of the Evaluation Section, Geothermal Supervisor's office will normally be one of the designated members and act as the Chairman of the Committee.

should also be responsible for preparing post sale memos required, recap of results to BLM;

The Conservation Manager shall be advised of the names of the Lease Sale Committee in a joint memorandum from the respective Area Geologist and the Geothermal Supervisor as soon as practical, and in any event, no later than five days after the receipt of a request for tract selection and parcelling.

2. Tract Selection and Parcelling. The Lease Sale Committee shall obtain information from the appropriate Area Geologist and staff of the Geothermal Supervisor and shall prepare a report giving the Geological Survey's recommendations. The contents of the report should be similar to the applicable portions of Division Manual Part 641.1A.3C. The report shall be prepared for the signature of the Regional Conservation Manager.

3. Evaluation Procedures. The Lease Sale Committee will be responsible for obtaining all available geologic, engineering, and economic data,

all Geologists.
Geothermal 1
Procedures 1 (Geothermal Sales)

and thoroughly evaluating same. The Lease Sale Committee will have the primary responsibility for preparing all procedures, information, and conclusions for a particular sale. The staffs of the Geothermal Supervisor and Area Geologist shall assist the Committee as necessary to assure compilation and full evaluation of all pertinent data. The Committee will outline, in writing for consideration by the Area Geologist, Area Geothermal Supervisor and Conservation Manager, the proposed evaluation method or methods for a particular sale at least four weeks prior to the sale date. Any final instructions regarding use of data and evaluation methods and procedures to be used or followed will be given to the Committee after the written presentation.

4. Evaluation Report. The results of the pre-sale evaluation, a discussion of the methods used, and all maps, charts, displays, calculations, other pertinent background data, etc. will be prepared for a briefing of the Area Geologist, Area Geothermal Supervisor and Conservation Manager at least five working days prior to a sale. All information is to be reduced into a packaged presentation that will contain sufficient detail to be filed as the final pre-sale evaluation in the absence of new data between then and the time of the sale.

Numerous geothermal lease sales are expected in this and the following fiscal year. Adherence to the above procedures should reduce the confusion surrounding some of the previous sales and allow all concerned to more properly plan for the expected heavy sale schedule.

(Original Sgd.) W. C. Gere

W. C. Gere

cc: Cons. Mgr., Central Reg.
O.S.&D. Section
ADC-Evaluation
ADC-Operations
SAD Section

HAO/med

Instructions needed on post-sale — letter to Chief CD. on sale results, BLM notification, etc.

"FOR GOVERNMENT USE ONLY"

Report of the Geothermal Lease Sale Evaluation Committee

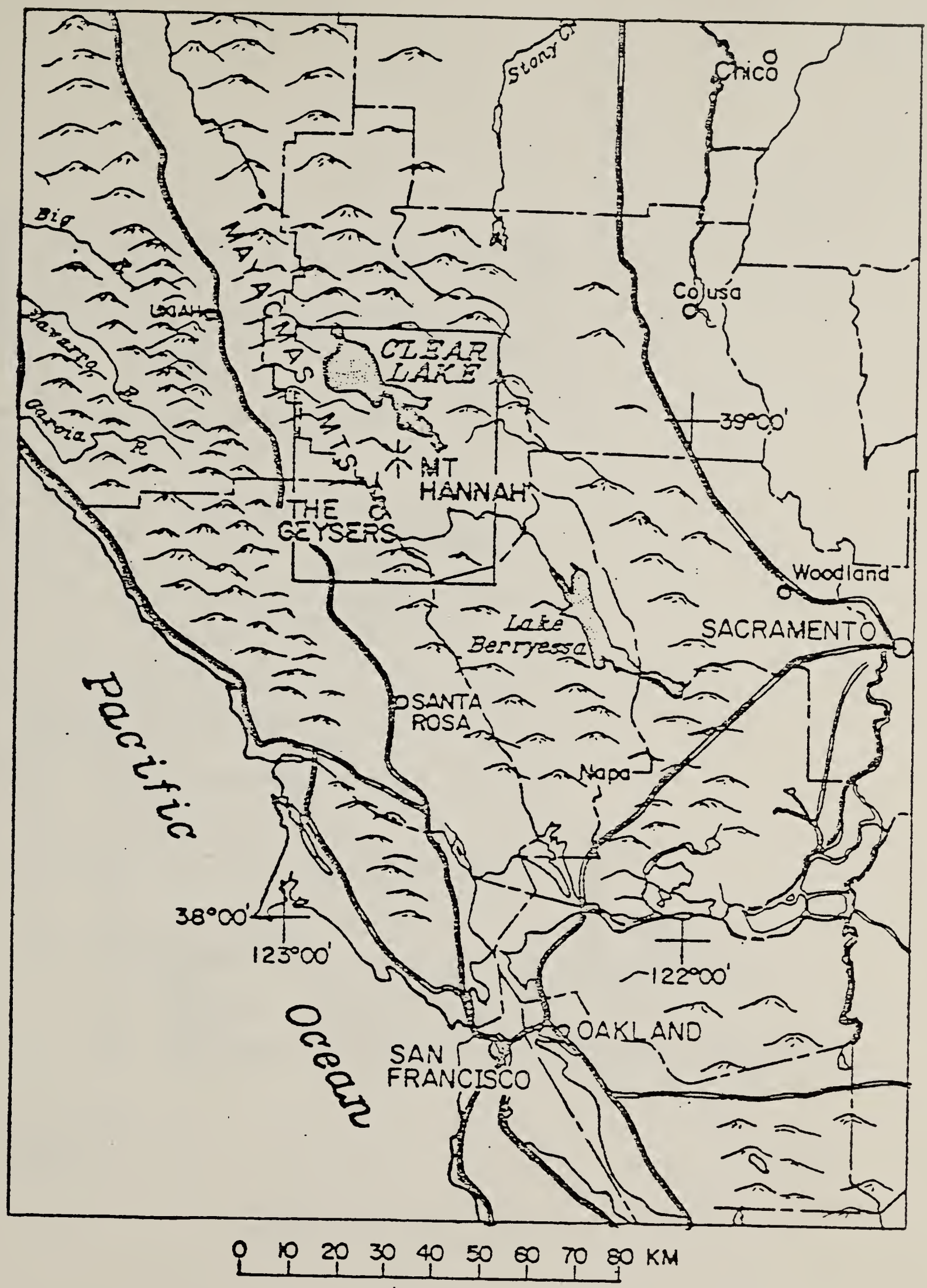
Date: August 26, 1977

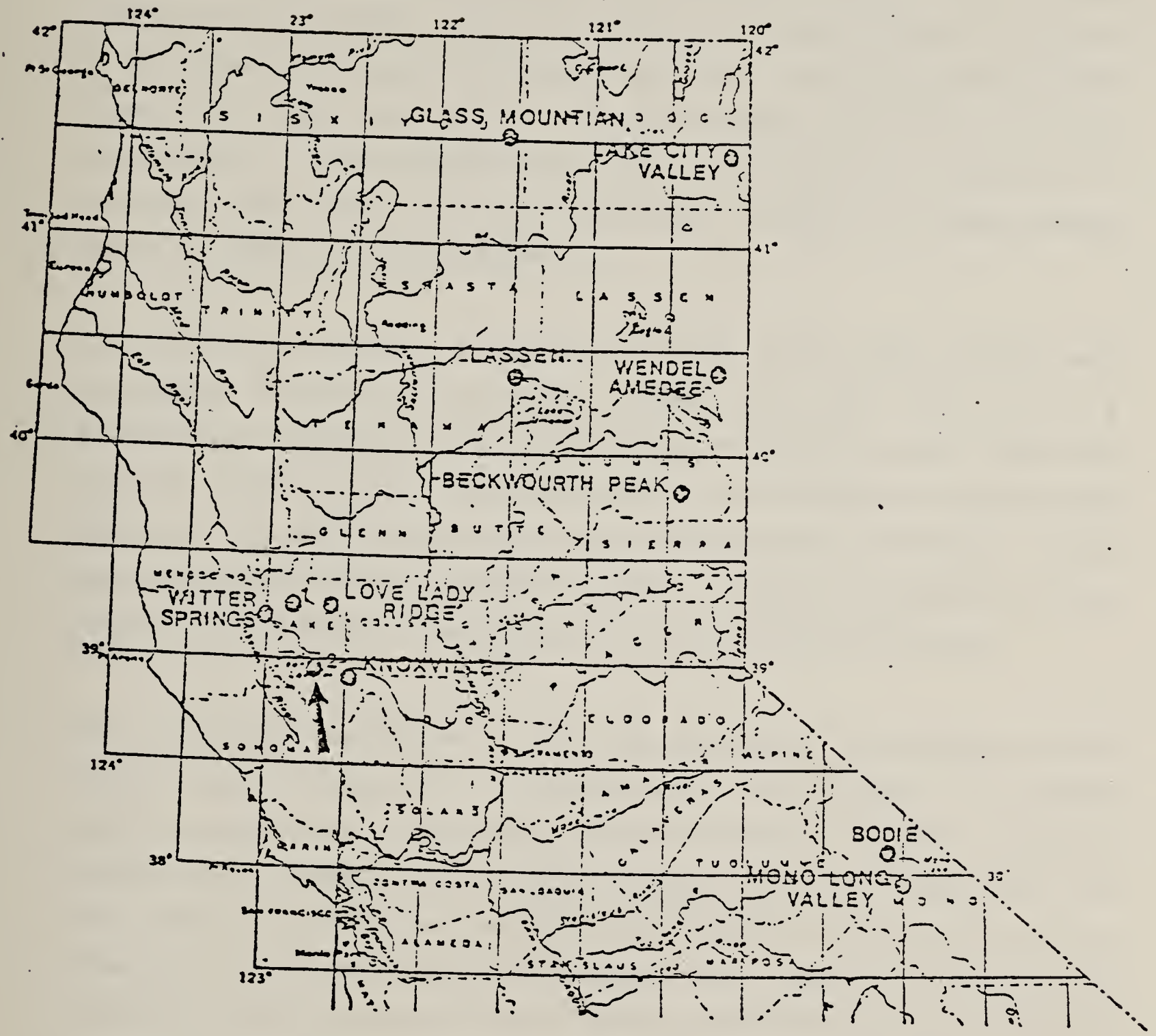
Subject: Geysers-Calistoga KGRA (California) Lease Sale of September 14, 1977

Evaluation Committee Present: J. Taylor, C. Brook, M. Reed, M. Furman, T. MacGillvray, W. Isherwood

INTRODUCTION

The Geysers and Calistoga KGRA's were established effective December 24, 1970 as initial actions under the Geothermal Steam Act of 1970. During January 1974, noncompetitive geothermal lease applications were filed on much of the Federal land between The Geysers and Calistoga KGRA's. Simultaneous filings resulted in a competitive overlap situation for many areas, indicating competitive interest as defined in 43 CFR 3200.0-5(K)(3). A review of the geology in the area between The Geysers and Calistoga KGRA's, subsequent to the filing of noncompetitive lease applications in January 1974, indicated that the two existing KGRA's should be consolidated and that lands southeast of the Calistoga KGRA should be added to the new KGRA. The resulting Geysers-Calistoga KGRA classification was signed on December 24, 1974, effective retroactively to February 1, 1974. The lands being offered for competitive lease sale on September 14, 1977 have not been previously offered.


Stony Cr
Chico
Big
Cobb Mtn
Loconah
Clear Lake
Colusa
39°00'
Mt Hannah
The Geysers
Woodland
Lake Berryessa
Sacramento
Santa Rosa
Napa
38°00'
123°00'
122°00'
Oakland
San Francisco
Pacific Ocean
0 10 20 30 40 50 60 70 80 KM



KNOWN GEOTHERMAL RESOURCE AREAS IN NORTHERN CALIFORNIA

GEOLOGY

The Geysers-Calistoga KGRA is located approximately 110 km north of San Francisco in the Clear Lake–Mayacmas Mountains region of the northern California Coast Ranges. All three leasing tracts being offered for sale are in the Mayacmas Mountains portion of the KGRA; tracts 1 and 2 are located along the main crest of the mountain range northwest and south, respectively, of The Geysers steam field while tract 3 is located on a subsidiary ridge east of the main Mayacmas Mountains. The three leasing tracts are widely separated (figure 1).

The areas to be leased are underlain by rocks of the Upper Jurassic and Cretaceous Franciscan assemblage. These rocks form the core of a southeastward-plunging antiform, sometimes referred to as the Mayacmas antiform, which has been highly modified by late Tertiary and Quaternary faulting. This complex structure forms the Mayacmas Mountains. Small exposures of late Tertiary domes and flows of rhyolitic composition occur locally in tracts 2 and 3. Landslides are common on mountain slopes.

The Franciscan assemblage in this area is typical of Franciscan rocks exposed over a large part of the California Coast Ranges. It consists chiefly of graywacke with varying amounts of shale or argillite. Altered intrusive and extrusive igneous rocks, usually mafic in composition and collectively referred to as greenstone, are second in order of abundance. Blueschist metamorphic mineral assemblages occur either as (1) schistose or gneissose tectonic inclusions (exotic blocks) associated with other tectonic inclusions along highly sheared zones and serpentinite contacts and in melange units, or (2) in graywacke and interbedded greenstone and chert that have been subjected to high pressure or deep burial metamorphism on a regional scale. Serpentinite is commonly present along faults and within shear zones in the Franciscan assemblage. Serpentinite and partly to completely serpentinized periodotite are believed to be displaced remnants

USGS
Conservation Div.
Western Region
Pacific Area Geology

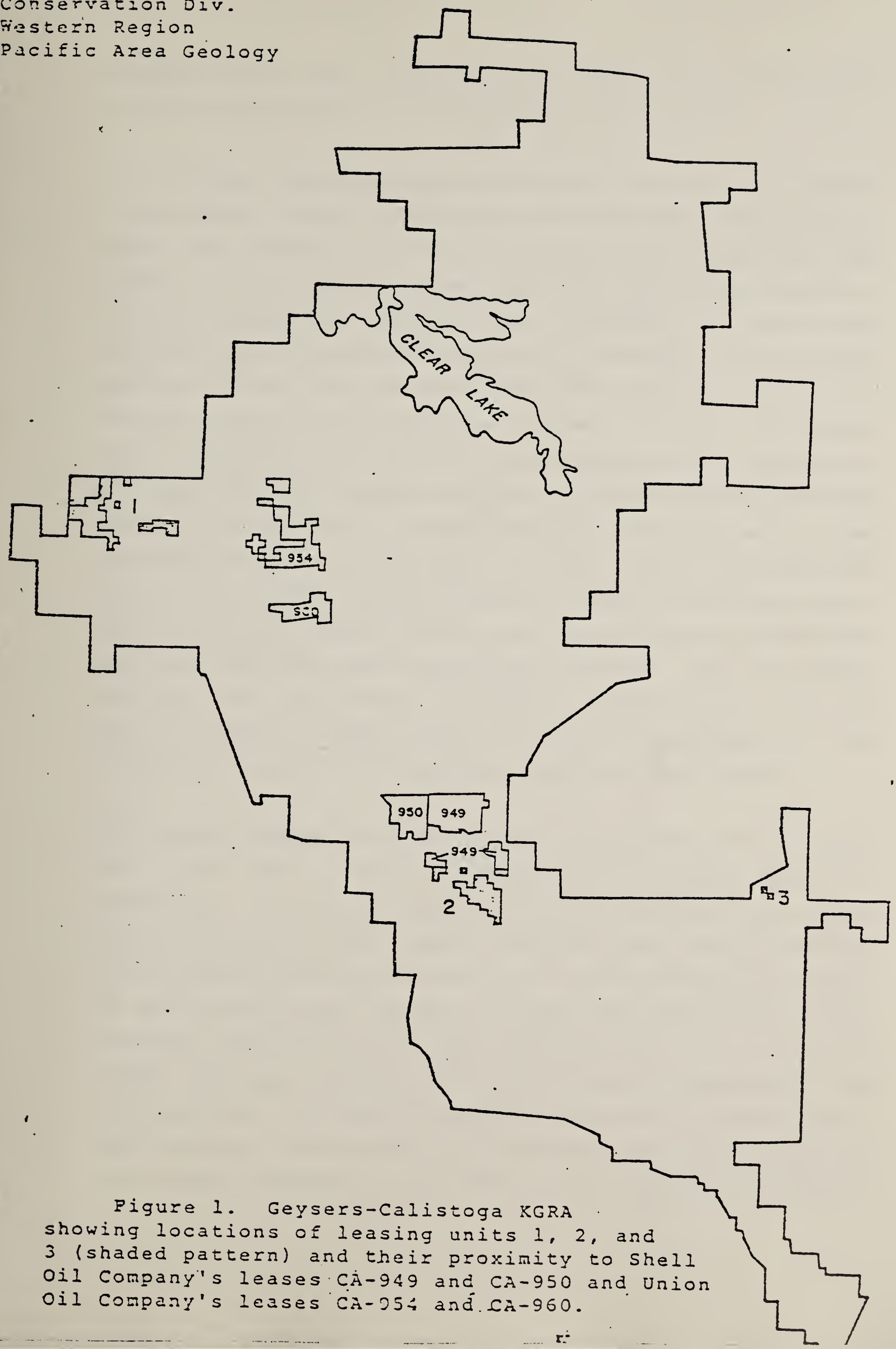


Figure 1. Geysers-Calistoga KGRA showing locations of leasing units 1, 2, and 3 (shaded pattern) and their proximity to Shell Oil Company's leases CA-949 and CA-950 and Union Oil Company's leases CA-954 and CA-960.

ophiolite (oceanic crust). The Franciscan is thought to have been deposited in deep ocean trench or arc-trench gap (Blake and Jones, 1974).

The Franciscan assemblage has been deformed and subjected to regional metamorphism related to high pressure and deep burial. At The Geysers steam field, McLaughlin (1975) and McLaughlin and Stanley (1976) have found that the structurally higher rock units exhibit higher degrees of textural reconstitution. Based on this, McLaughlin has defined three structural units. The lowest, structural unit 1, is exposed west of the steam field but has not been identified within the steam field. Unit 1 is a relatively intact, flysch-like sequence of graywacke with minor interbedded shale, compressed into tight folds and containing incipient pumpellyite. Structural unit 2 is a broken formation of imbricate tectonic slabs which generally are composed of relatively intact well-bedded graywacke, minor interbedded shale and conglomerate, and locally abundant greenstone and chert. The larger intact slabs are separated by highly sheared shaly zones of tectonic melange. Rocks of structural unit 2 have incipiently to moderately developed fabric and contain pumpellyite $\pm$ lawsonite. Unit 3, the highest structural unit, has identical lithologies to structural unit 2, the only difference being the higher degree of textural reconstitution and the presence of lawsonite $\pm$ sodic amphibole $\pm$ jadeitic pyroxene in unit 3.

The extreme structural complexity of the Franciscan rocks in The Geysers area is the result of extensive faulting related to several episodes of deformation. Deformation producing the three structural units largely predates the late Cenozoic regional warping and block faulting associated with formation of the Mayacmas antiform. The early deformation is thought to have occurred during eastward subduction and metamorphism of the Franciscan rocks beneath the Great Valley Sequence prior to about 30 million years ago (Atwater, 1970) and is probably responsible for the imbricate high- to low- angle thrust faults that separate tectonic slabs in the Franciscan. In The Geysers area, these thrust slabs trend northwest and dip northeast at moderate angles (McNitt, 1968; McLaughlin and Stanley,

1976; McLaughlin, 1977). Younger, steeply dipping, northwest-trending faults with dip- and strike-slip components are superimposed upon the older thrust faults. An east-west trending, steeply dipping, possibly extensional fault set is also present in the area. The northwest- and east-west trending faults are believed to have had movement during the late Quaternary and are probably related to the San Andreas system (Donnelly and others, 1976). Microearthquakes along northwest-trending faults in The Geysers steam field (Hamilton and Muffler, 1972) further suggest recent fault activity in the area.

McLaughlin and Stanley (1976) believe that steam reservoirs at The Geysers are in part related to local fault-controlled structural traps. The distribution of vapor and hot water within individual reservoirs is governed largely by fracture networks in slabs of otherwise impermeable graywacke (McLaughlin, 1977). The fractured reservoir rocks are sealed and isolated both vertically and laterally (McLaughlin, 1977; Garrison, 1972) by such impermeable Franciscan rock types as shaly melange, sheared greenstone, metagraywacke, and serpentinite. Based on geologic, geochemical, and geoelectrical evidence, McLaughlin (1977) and Goff and others (1977) infer that the steam field is bounded on the southwest by the Mercuryville fault zone and on the northeast by the Collayomi fault zone. The northwest and southeast limits of the field have not been precisely defined.

Because of the imbricate nature of the thrust slabs and their modification by late Tertiary and Quaternary strike-slip and normal faulting, and because of the likelyhood that fracture networks within reservoir rocks are haphazardly arranged, zones of steam production both within and between reservoirs can be localized and occur at several different levels. Thus, the surface geology is not necessarily an indicator of whether or not steam is present in the subsurface.

Leasing Tract 1

Leasing tract 1 is about 11 km northwest of the nearest producing steam well. As shown by McNitt (1968), this area is underlain by rocks of the Franciscan assemblage. McNitt subdivides the Franciscan into two mapable units. The upper unit consists of interbedded sandstone and shale and is equivalent to McLaughlin's (1975) structural unit 2. McNitt's lower unit consists of mostly massive graywacke with interbedded chert, basalt, and less than one percent shale and conglomerate; this unit is equivalent to McLaughlin's structural unit 3. Discontinuous bodies of serpentinite, diabase, and metamorphic rocks are scattered throughout the lower unit.

Leasing tract 1 lies northwestward along the structural trend of The Geysers steam field; and, although the lithologic units and structures which contain steam at The Geysers are probably co-extensive with those in tract 1, the existence of geothermal indicia is not known in this area. Sun Oil Company and its subsidiary, Cordero Mining Company, have drilled two geothermal exploratory wells on nonfederal lands in the area. One well is in sec. 13, T. 12 N., R. 10 W., near the leasing tract and one well is in sec. 24, T. 12 N., R. 10 W., about 1.6 km south of the leasing tract. Both wells were unproductive and are abandoned. The well in sec. 24, Torchio-Ferro #1, had a maximum temperature of 126°C at 2135-2288 m.

Leasing Tract 2

Most of leasing tract 2 is within 4 km south of producing steam wells on Shell Oil Company's Federal leases CA-949 and CA-950. McLaughlin (1975 and unpub. map) shows that most of this tract is underlain by a thick serpentinite body. This serpentinite is continuous with serpentinite underlying Federal leases CA-949 and CA-950 where it is as much as 670 m thick. Other major rock units in the tract are greenstone and melange of both structural units 2 and 3. Pliocene rhyolite flows assigned to both the

Clear Lake and Sonoma volcanic series are exposed within the leasing tract. Jurassic diabase and gabbro are exposed in the very southern part of the tract. An extensive landslide is located in the northern part of the area and smaller landslides occur elsewhere.

The structure of leasing tract 2 consists of complexly folded and faulted thrust slabs similar to the structure of leases CA-949 and CA-950. As with tract 1, there are no surface indications in tract 2 which would suggest the existence of an active geothermal resource. The Pliocene volcanic rocks within the leasing tract have not been dated, but rhyolite from a flow on Mount St. Helena about 4 km to the southeast has been dated at 2.9 ± 0.2 m.y. (Mankinen, 1972) and rhyolite from a hydrothermally altered dome and flow on Pine Mountain about 0.8 km to the north has been dated at 2.04 ± 0.04 m.y. (Hearn and others, 1976). The volcanic rocks are too old and too limited in extent to be of any importance as a residual heat source.

Leasing tract 2 is in the Eastern Mayacmas quicksilver (mercury) district, but there are no mines reported within the boundaries of the tract. Yates and Hilpert (1946, p. 279) report that the Bacon Consolidated mine (formerly the Barnum mine) lies in the southern parts of secs. 11 and 12, T. 10 N., R. 8 W., about 0.5 km to the north of the leasing tract. The mine is not shown on current topographic maps. Yates and Hilpert give the following account of the mine:

> "It was discovered in 1859 or 1860, and by 1865 had a few hundred feet of shallow workings. It reputedly produced about 300 flaskes of quicksilver during the years of 1876 and 1877, but has since been abandoned. It is now merely an assemblage of caved adits and brush-covered pits and trenches. The size of the dumps indicates that the mine was never extensive. Several ledges of silica-carbonate rock cross the area, and the ore was apparently in this material."

Silica–carbonate rock, the host rock for many mercury deposits in the Coast Ranges of California, formed through hydrothermal alteration of serpentine by acidic CO_2-rich waters (Barnes and others, 1973) ascending along fractures and faults. In the Eastern Mayacmas district, Yates and Hilpert (1946, p. 241) favor a post-Sonoma volcanics age (late Pliocene) for the silica–carbonate alteration, with ore deposition occurring shortly afterwards (p. 252). Hydrothermal alteration of other rock types also occurs sporadically along several of the faults in the area. The youthfulness of the hydrothermal alterations and ore deposition is not established with certainty. Neither McLaughlin (unpub. map) nor Yates and Hilpert (plate 29) show recent alteration of landslide material in the area in contrast to the recently altered landslides in The Geysers steam field. This factor can be interpreted as indicating that hydrothermal activity in the area of leasing tract 2 has long since ceased and that hydrothermal fluids no longer exist at depth. Alternatively, the lack of recent hydrothermal alteration may only indicate that channelways leading from the reservoir to the surface have been sealed. Although mercury deposits and hydrothermal alteration can be used as a guide in geothermal exploration, their presence alone does not assure the existence of a geothermal resource in the subsurface.

The nearest producing geothermal wells are 4 km to the north on Shell Oil Company's drill pad B, Federal lease CA-949. Here, wells 11-1 and 11A-1 are capable of producing steam in commercial quantities. Proprietary data: Initial test production of well 11-1 through a 11.4 cm orifice plate was 88,000 lbs/hr (11.11 kg/s) of steam; initial test production of well 11A-1 through a 22.2 cm orifice plate was 175,000 lbs/hr (21.95 kg/s) of steam. Steam entries in both wells occur at about 1500 m vertical depth and deeper in graywacke and below a silicified zone rich in quartz veins. The silicified zone thickens and occurs at greater depths southeastward across leases CA-949 and CA-950. If this zone is a caprock to the geothermal reservoir, then it is likely that any geothermal resource beneath leasing tract 2 occurs at substantially greater depths than in the area leased. Shell has also drilled

two nonproducing wells in the area. Well 76-3 on lease CA-950 about 1.6 km west of wells 11-1 and 11A-1 encountered only limited quantities of steam (apparently due to tight formation) but very high temperatures; maximum temperature was 224°C at 2402 m depth. Shell's "Bounsall" well on fee land about 3 km east of the leasing tract was apparently a cold hole.

Leasing Tract 3

Leasing tract 3 is over 17.6 km east of the nearest producing steam well. The tract is underlain by tuffs assigned to the Pliocene Sonoma Volcanics (Fox and others, 1973) and serpentinite. There are no geothermal indications in the area.

GEOPHYSICS

Considerable geophysical data of a reconnaissance nature exist in the region and apply to The Geysers region as a whole. Specific data available to this office that apply to individual lease tracts are less complete, but can give a good general idea of the tracts' potential for steam production. Presently, the most useful geophysical tools for targeting exploration drillholes at The Geysers are temperature gradient borehole surveys, some of the electrical resistivity methods, and perhaps gravity. Data reviewed for this evaluation includes the following:

1. Complete Bouguer and residual gravity anomaly maps at scale 1:62,500 (Isherwood, 1976), with additional data critical to the leasing tracts added by this office;

2. Aeromagnetic and filtered aeromagnetic contour maps, scale 1:62,500 (U.S. Geol. Survey, 1974, and Isherwood, 1975);

3. Various model-diagrams based on the massage of gravity and magnetic data (Chapman, 1975, and Isherwood, 1975);

4. Dipole-dipole apparent resistivity contour maps, scale 1:62,500, adjacent to and northeast of the producing steam field (Stanley, et al, 1973);

5. Schlumberger electrical soundings along a generally east-west traverse crossing at Mt. Hannah area (Stanley, et al, 1973);

6. Audio-magnetotelluric survey results in the vicinity of tract 2 (Long and Senterfit, 1976);

7. Microearthquake epicenter maps (Lange and Westphal, 1969; Hamilton and Muffler, 1972; C. Bufe, personal communication);

8. Preliminary teleseismic p-wave delay results (H. Iyer, personal communication);

9. Active seismic reflection results in a limited area (R. Denlinger, personal communication);

10. Near surface temperature gradients compiled from well data available to the Conservation Division, U.S.G.S.

The broad exploration target for future development of The Geysers geothermal field is determined by the distribution of producible wells, and by structural trends as evidenced by temperature gradient, electrical conductivity, and extensions of a gravity low which overlies areas of known production. Of the three tracts offered, only tract 2 is inferred to be included within the prime exploration region. Because of the coarseness of data resolution, all of the area in tract 2 is presently considered to offer potential for geothermal power production.

The major gravity low of about 25 to 30 mgal closure is centered over Mt. Hannah, approximately 5 km northeast of the main steam field (Figure 2). This low is superimposed on a steep regional gravity gradient that decreases

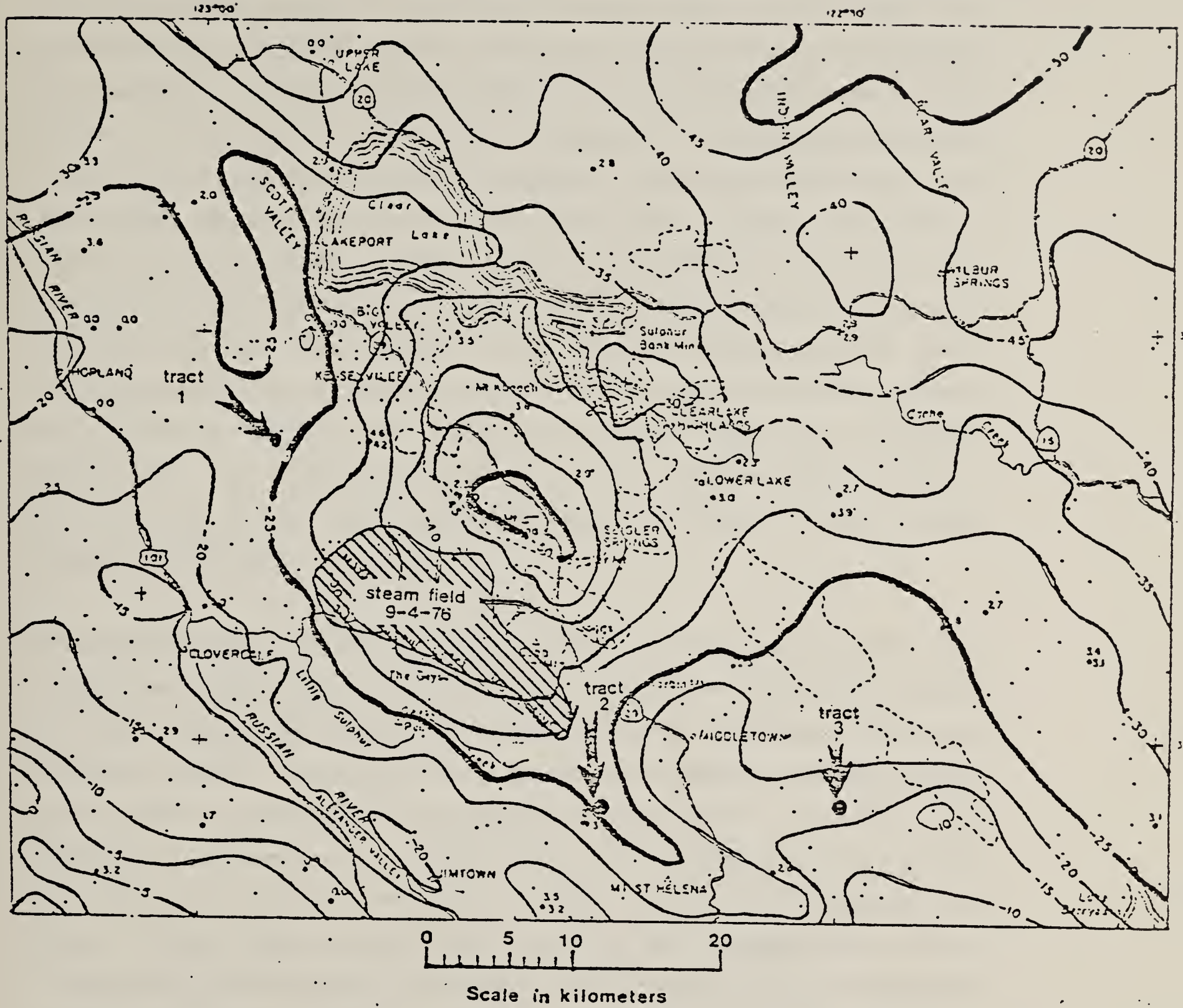


Figure 2. Bouguer gravity contour map of The Geysers region, with present steam field and tract locations. From Chapman, 1975.

to the northeast across this portion of the Coast Ranges. The regional gravity gradient reflects the transition between denser oceanic crust to the southwest and less dense, silicic, continental crustal rock to the northeast. As discussed by Hamilton (1969), Ernst (1970), and Alt and Hyndman (1975); slices of eugeosynclinal, sea floor materials were emplaced against the continental mass along an ancient subduction zone as the oceanic plate slid and dipped easterly beneath the continental plate. Later, in the last 15 million years, transform faulting along the San Andreas and related faults has replaced subduction at the California plate boundry. Igneous rocks were intruded into the Coast Ranges as the Mendocino triple junction moved northwestward. The geothermal reservoir at The Geysers is probably related to a still-hot magma body and fracture zones within the Franciscan graywacke. A representation of the major tectonic events prior to formation of the San Andreas fault is shown in Figure 3, from Alt and Hyndman (1975, p4).

The gravity low at Mt. Hannah has been interpreted to be an expression of a magma body providing the thermal source for both the Clear Lake Volcanics and The Geysers as reported by Garrison (1972), Isherwood (1975), and Chapman (1975). Isherwood (1975) performed extensive modeling studies from both the gravity and aeromagnetic data across the KGRA, and produced a residual gravity anomaly map which divides the major gravity low into two contoured lobes, one on either side of the Collayomi Fault Zone. These lobes are referred to as the "Mt. Hannah low" and the "Production low", as shown of Figure 4. The general extent of producible wells at The Geysers and the locations of the three tracts being offered for lease are also included on Figure 4. Isherwood has modeled a southwest-to-northeast generalized cross-section through the inferred silicic magma body and proposes protuberances of the magma chamber as a major cause of the double-lobed gravity contour configuration. Isherwood (1975) also considers that some of the "Production low" anomaly may be caused by reservoir structure, and Chapman (1975) explored the hypothesis that the water-steam

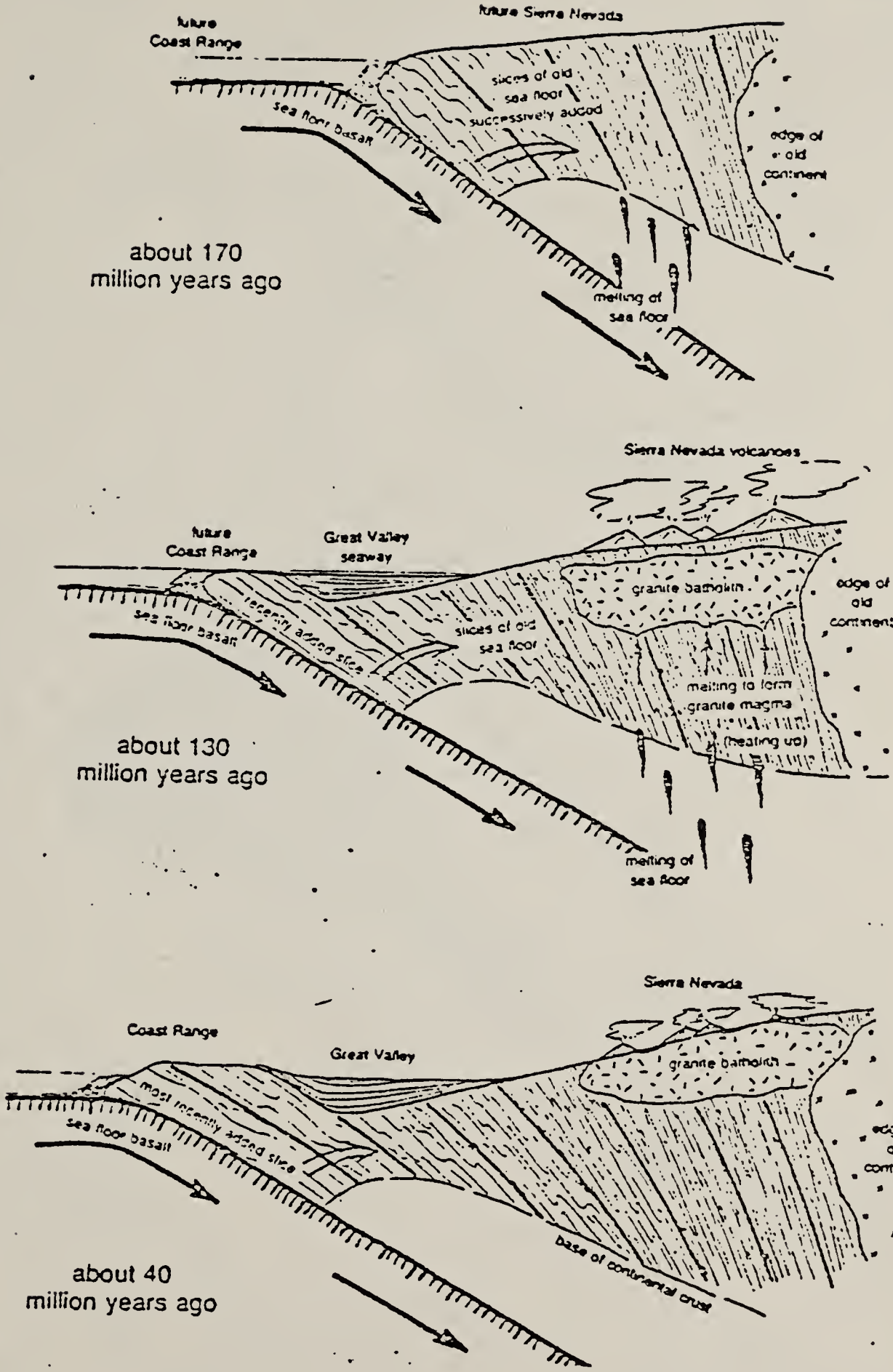


Figure 3. Crustal tectonics, western California, from Alt and Hyndman (1975), p. 4.

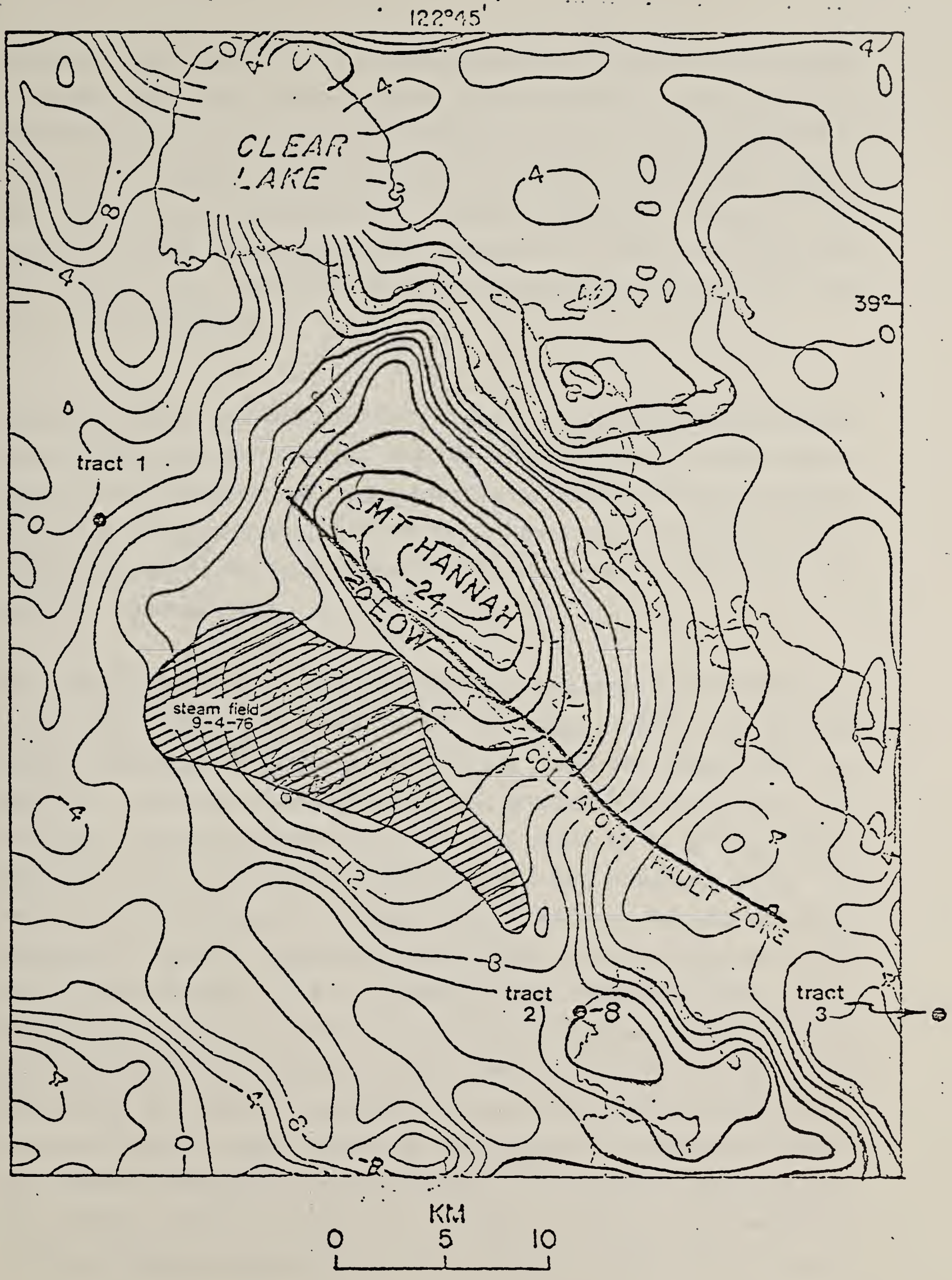


Figure 4. One residual gravity contour map of The Geysers region ($2.67\ g/cm^3$ reduction; 2-mgal contour interval). From

reservoir may contribute to the major Bouguer gravity low anomaly. Depending upon the density contrast chosen, depths to the top of the inferred magma body are various calculated from about 2 to 7.5 km (6,500 to 24,600 ft) by Chapman (1975) and Isherwood (1975). Such a still-hot magma body has not been approached by drillholes exceeding a depth of 3 km (10,000 ft) in The Geysers region (e.g. Aminoil No. 3 Davies Estate, Sec. 31, T. 11 N., R. 7 W., and Union Oil Co. No. 4596-24 Dx State, Sec. 18, T. 11 N., R. 8 W., MDBL&M).

Recently acquired data indicates that, in detail, the southeastward extension of the "Production low" anomaly probably terminates near the north edge of tract 2 to the southeast, and clearly terminates before reaching the vicinity of tract 1 to the northwest. Although tract 3 does not have detailed data, it clearly lies beyond the limits of any gravity trend related either to the heat source or reservoir rocks.

The aeromagnetic contour maps, including residual map representations, all reflect the northwest structural trends, i.e., magnetic rocks are generally aligned subparallel to faults; some of these faults are mapped from the surface. The same source-bodies do not produce both the gravity and magnetic anomalies (Isherwood, 1975), and there is no direct relation apparent between the gravity and aeromagnetic data (Chapman, 1975). The sources of the aeromagnetic anomalies appear shallower than the sources of the gravity anomalies. Serpentinite and volcanic rocks on topographic highs are the main sources of the aeromagnetic highs. Isherwood (1975) applied "upward continuation" as a filter for the near-surface magnetic effects and generated residual aeromagnetic contour maps at 3, 5, and 7 km above the flight level. The residual aeromagnetic map at 3 km upward continuation is shown in Figure 5, which subdues the near-surface and topographic effects and enhances the major magnetic anomalies. The elongate Collayomi Fault high anomaly shown on Figure 5 is inferred to reflect a near-vertical or northeast-dipping serpentinite-rich slab associated with that fault zone.

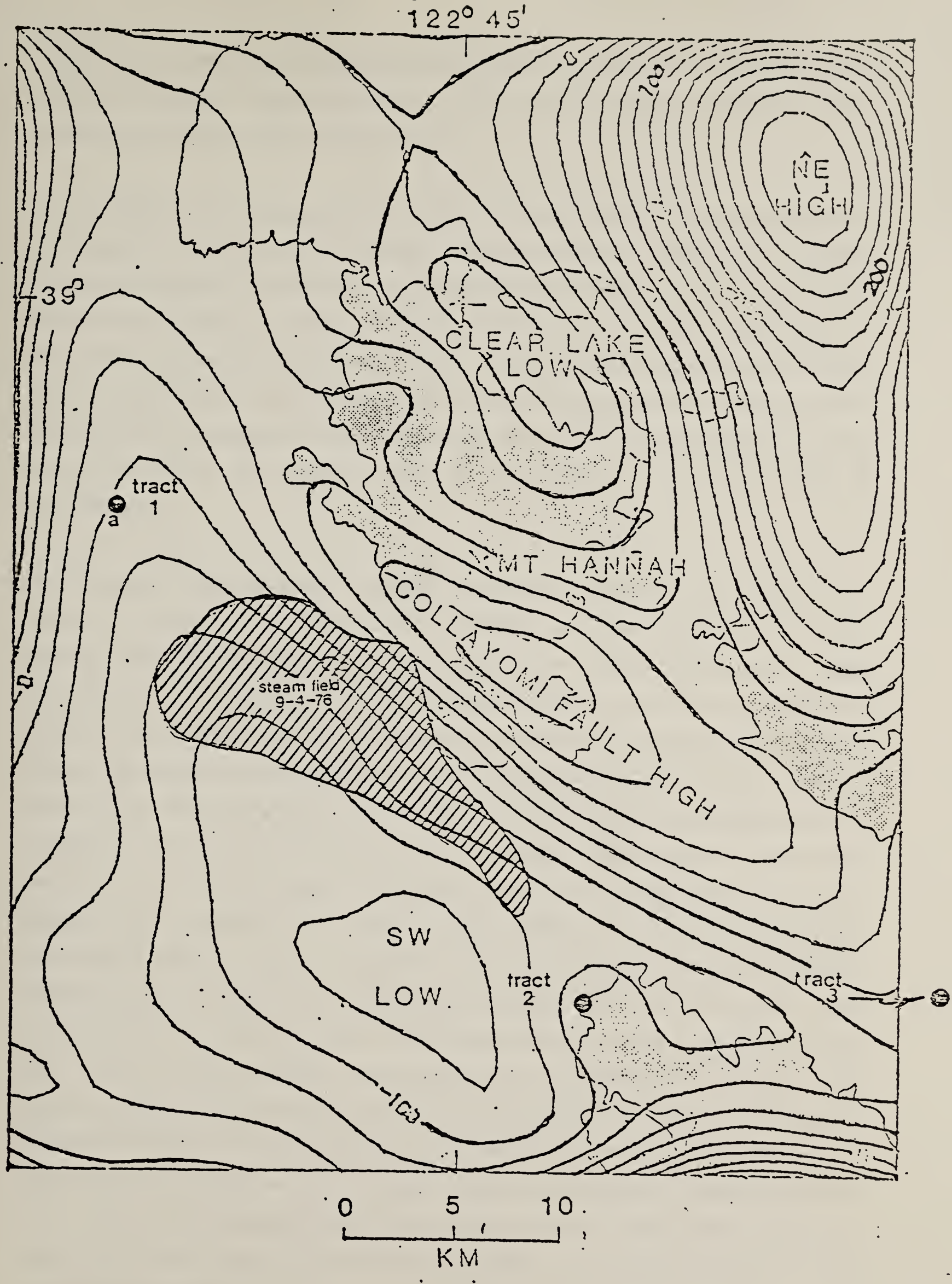


Figure 5. Reduced aeromagnetic contour map of The Geysers region (3 km upward continuation; 20-gamma contour interval). From Isherwood, 1975.

Such a fault zone with emplaced serpentinite may cap a convecting hot zone under Mt. Hannah and contribute to the direction and channeling of heat transfer by fluids to The Geysers area.

The sources of the magnetic anomalies in The Geysers-Mt. Hannah area are estimated to extend only several kilometers deep. The lack of deeper magnetic sources in this area of demonstrated mass anomaly may reflect deeper materials in excess of their Curie Point, and thus exhibiting no magnetic expression (Isherwood, 1975). General shallowness of microearthquake hypocenters can be related to elevated temperatures. Hamilton and Muffler (1972) estimated hypocenter depths for 53 microearthquakes over a 3-week period in The Geysers region to range down to a maximum depth of about 4 km.

A composite dipole-dipole apparent resistivity contour map prepared by Stanley, Jackson, and Hearn (1973), reveals a large resistivity low that nearly coincides with the Bouguer gravity low about Mt. Hannah. This resistivity low of about 1 to 5 ohm-meters trends northwest and appears to be bounded by fault zones. Schlumberger electrical sounding measurements across the dipole-dipole resistivity low indicate subsurface layering. Values from 15 to 570 ohm-meters were measured and modeled into layers down to a depth of about 1 km adjacent to Mt. Hannah. These shallow layers were assigned to Tertiary-Upper Cretaceous volcanic or sedimentary rocks by Stanley and others (1973). Below these layers is a thick, electrically conductive layer or body of about 2 to 3 ohm-meters with a minimum bottom depth of about 4.6 km under Mt. Hannah. This low conductivity may be partly due to Great Valley marine sedimentary rocks containing saline pore waters with possibly anomalously high temperatures (Stanley and others, 1973). It is also aptly noted by those authors that the large amounts of marine shales and mudstones in the Great Valley sequence could be quite electrically conductive even without high temperatures. Electrical basement below the conductive body was only sounded at one station, about 3.2 km west of Mt. Hannah, and that sounding does not reveal the nature of the electrical basement.

Chapman (1975) suggests that these electrical resistivity results are not inconsistent with the hypothesis of a reservoir (or reservoirs) of hot water below Mt. Hannah and the Clear Lake volcanic field, in turn underlain by a heat source. Based only upon these resistivity data, that hypothesis is conjectural. However, the electrical sounding data support gravity estimates that would place the top of an inferred, still-hot magma body at a depth of at least 5 km below Mt. Hannah.

Microearthquake surveys were mentioned in the previous discussion of aeromagnetic data. Continued seismic monitoring across The Geysers region confirms earlier surveys of Hamilton and Muffler (1972) that there is a concentration of microearthquakes (magnitude less than 1) associated with faults across the producing steam field, at focal depths less than about 4 km. These microearthquakes may in part be related to subsidence resulting from fluid production (C. Bufe, personal communication).

Deep seismic reflection soundings were performed using the Vibros-seis technique by R. Denlinger (personal communication), along traverses in the Castle Rock Springs area, about 4.8 km north of tract 2. Preliminary correlations with well data were also performed. Although analysis of the data have not been completed, several preliminary interpretations have been put forth by Denlinger:

1. No molten magma chamber or body was sounded under the Castle Rock Springs locale to a maximum resolution depth approaching about 8 km (27,000 ft, 2-way travel time at 4 seconds). (This is south of the area hypothesized by others to be underlain by magma.);

2. Typically, velocity impedances produce mappable wave-train amplitudes that relate to separate lithologic units;

3. Franciscan lithologic units (serpentenite, graywacke, etc.) are often in slices separated by steep imbricate faults, and are much more numerous in the upper 3 km of the subsurface rocks than in lower intervals;

4. Initial results encourage the correlation of steam-entry fracture zones encountered in the wells with certain reflective zones;

5. The northwest-trending Mercuryville Fault Zone may be speculated to dip northeast in the neighborhood of 75°, and provide a boundary to fluid migration from the inferred heat source under Mt. Hannah.

Teleseismic monitoring surveys were reported upon by H. M. Iyer (American Geophysical Union conference, San Francisco, 1975). Delay residuals of p-wave arrivals across the region of The Geysers were plotted to model a low-velocity body within the crust with a depth extent exceeding 5 to 10 km. The teleseismic survey is presently expanded and enhanced to further investigate the hypothesis that such a low-velocity body is a molten magma chamber. Preliminary indications are that the low-velocity body does in fact exist (H. M. Iyer, personal communication).

No heat flow data is public in the neighborhood of any of the lease tracts. Our closest information is from the Shell Oil Co. wells to the north of tract 2. Indications here are that near surface temperature gradients decrease to the south, nevertheless adequate reservoir temperatures are still reached at practical drilling depths. This trend suggests, however, that tract 2 probably lies near the southern limit of the field and deeper drilling may be required for production.

In summary, there appears a fair chance that tract 2 could some day produce commercial steam. It is rather far from the inferred heat source, but has a good chance of containing reservoir rocks through which migrating fluids could provide heat transfer. This reservoir will probably be deeper and consequently more difficult to tap than in the adjacent Shell leases to the north. Tract 1 is given very low probability of ever becoming commercially productive, although some geologic quirk may provide connection to the heat

source and reservoir rocks by some unforeseen mechanism. Tract 3 is viewed as a complete wildcat area with no generic connection with The Geysers systems. The sparse data available does not suggest geothermal potential.

RESERVOIR ENGINEERING

The extent of the dry steam reservoir at The Geysers is presently unknown. A large number of wells have been drilled and many well tests have been conducted in the main field, but most of the data has not been released for publication. Therefore the reservoir engineering considerations in this report are based on data from wells drilled on nearby federal and state leases. Unfortunately, all of these wells are either non-productive or are shut in awaiting construction of power plants. Thus no production data is available from which to quantitatively determine local reservoir properties.

It should be noted that extension of The Geysers-Calistoga KGRA to include the lands which are presently being offered was based upon competitive interest, rather than on the presence of specific geothermal indicia in the areas.

Of the three tracts to be offered, tract 2 appears to be the most promising. Tract 1, located some 14 km northwest of the main Geysers field, is bounded to the southeast by three dry wells, all drilled to total depths of 2130 m 2440 m, with measured bottom hole temperatures of 128°C to 133°C. Therefore this tract may be beyond the northwest limit of the steam reservoir. For tract 3, far to the southeast of any presently commercial area, we have no direct information, and no geothermal indicia are present. Aminoil's well BJ-1 (sec. 18, T. 10 N., R. 6 W.) was drilled to a total depth of 3,117.5 m before drilling was suspended in July 1976.

By contrast, tract 2 is bounded to the north by Federal leases CA-949 and CA-950, held by Shell Oil Company. Shell has drilled seven deep exploration wells (six of which are capable of producing commercial quantities of steam) and several shallow temperature gradient holes on these leases. Another Shell well (Bounsall) located to the east of tract 2 in sec. 16 was drilled to a depth of 2410 m and abandoned. No consistent trend toward decreased flow rates in the producing wells to the southeast could be detected, and flowing temperatures in these wells were consistent with those measured in the early life of wells producing from the main field (100,000 - 200,000 lb/hr at 163°–177°C). However, there does appear to be some trend toward deeper initial steam shows as one moves southeast, indicating either a permeability pinch out or increased caprock thickness. Finally it should be noted that measured enthalpies of produced fluid from these wells are some 5 to 20 Btu/lb lower than for steam in the main field (≈1,200 Btu/lb). This last fact does not require that we are at the edge of the field, but may arise from the lack of production. As the well is produced, fluid near the wellbore will be depleted drying the reservoir rock. As the zone of steam depletion increases, the path of the steam to the well increases in length, with consequent nearly isothermal heating of the steam by the reservoir rock, increasing its enthalpy (Truesdell and White, 1973).

In summary, tract 2 is adjacent to what appears to be a typical section of The Geysers steam reservoir (although steam probably lies at greater depths than in CA-949 or CA-950) while tract 1 may be beyond The Geysers reservoir. Not enough information is available to evaluate the potential of tract 3.

HYDROLOGY

Little hydrologic information is available which can be applied to the evaluation of these tracts. Ground-water investigations in The Geysers area address water-bearing units and no water bearing units exist in the vicinity of these tracts. In the steam field production area of The Geysers ground-water is generally not encountered at depth. There have, however, been a

few instances of ground-water inflow in steam well drilling as faults or open fractures are penetrated. These inflows, however, do not persist. Steam wells drilled outside the production area often encounter water at depths below 1,200-1,500 meters.

Precipitation in the area of the tracts varies spatially from 100 to 188 cm per year. The soil cover in the area is very thin, and the rocks underlying the tracts generally have poor water-bearing properties. Therefore, very little precipitation enters the ground-water system in the immediate area of the tracts.

Because of the poor water-bearing properties of the rocks in the area of the tracts, springs or wells exist generally only where the rocks are fractured. Ground-water does accumulate to a degree in the melange terrane. The matrix of melange often contains blocks of relatively more porous rock. Precipitation which percolates through the permeable rock is contained at the block-matrix contact and may issue as springs at these contacts. Flow from cold springs may also originate from infiltrated precipitation that migrates along fault planes, shear planes of slump blocks, or contacts with the volcanics. At a location 16 km southeast of tract 1 and 13 km northwest of tract 2 the ground-water level in fractured bedrock (Franciscan assemblage) varies between approximately 11 and 15 meters below ground surface (Earth Sciences Associates, 1977).

No identified hot springs occur within the tracts or in their immediate vicinity. Chicken Springs, presumably cold, occurs in tract 1. There are no data on Chicken Springs. Several other springs, with median temperatures of 13°C and 19°C occur within 5.5 km of tract 1. These springs have total discharges which range from 0.5 to 1.3 l/sec. Several other springs, also presumably cold, occur within approximately 3 km of tract 2. There are also no data available on these springs.

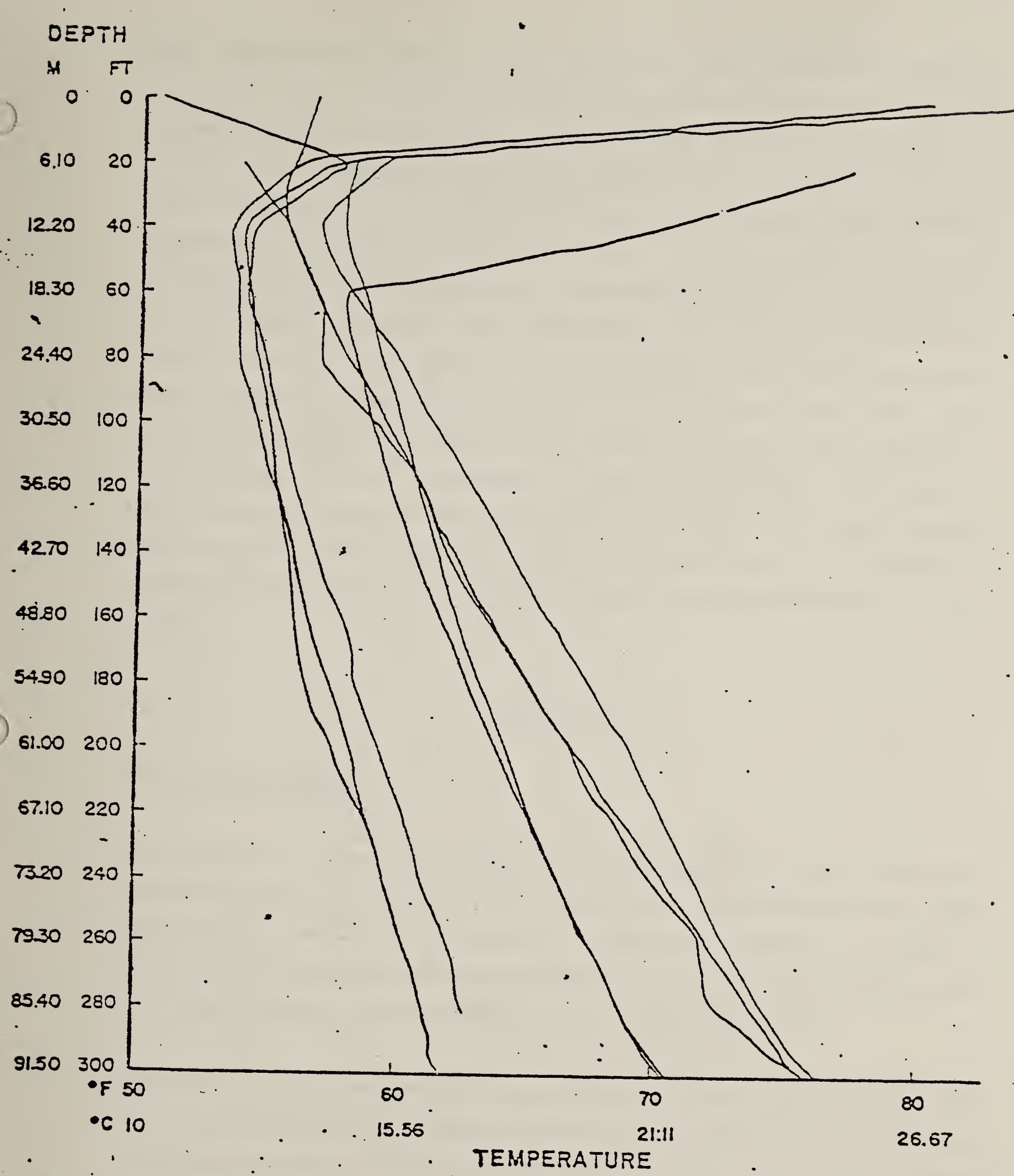


FIG. 6. OBSERVED SHALLOW TEMPERATURE GRADIENTS NORTH OF LEASING UNIT NO. 2.

Eight shallow temperature gradient holes have been drilled to a depth of 91.5 m on leases CA-949 and CA-950, immediately north of tract 2. The temperature gradient data from the holes closest to tract 2, a distance of 2 to 3.2 km, are presented in Figure 6. These profiles, within the first 12 m, show the influence of seasonal variations, in this case ambient surface temperature variations. At depths between 12 to 30 m, and 79 to 91 m, two of the temperature profiles shows perturbations which could be interpreted as movement of relatively cold ground-water. The location of one of these holes is close to a cold spring. These temperature gradients for the most part, however, appear characteristic of conductive heat flow. The temperature gradients range from 60°C/km to 150°C/km. The significance of this range is open to question. It can be explained in large part by differences in thermal conductivity of the rock types. The range may also indicate a convective influence —i.e., upward movement of hot water, or selective damping of the conductive profile by downward movement of cold water.

ECONOMICS

Background & History

The Geysers, a relatively remote area in Sonoma, Lake, and Mendocino Counties about 110 km north of San Francisco, encompasses lands controlled by the State, the Federal government, and private individuals. Currently it constitutes the only commercial geothermal power project in the U.S., and in terms of total megawatt capacity, is the world's largest.

The initial attempt to develop commercial power at The Geysers was in 1922 when drillers successfully tapped the steam source. Abrasives and corrosion, however, precluded economic development at that time. In 1956, Magma Power and Thermal Power (working co-jointly) successfully drilled into an area of steam having sufficient economic quantities for commercial production. Thereafter, Pacific Gas & Electric (PG&E) contracted to buy

steam and build a power plant to provide electricity within their regulated area. Magma and Thermal merged their holdings at The Geysers with Union Oil Co. of California in 1967, with Union being named operator of the aggregate project. The following table reflects the various power plant units, the year of their establishment, their kilowatt capacity, and conversion efficiency:

P.G.& E. UNITS - THE GEYSERS, CALIFORNIA

YEAR	UNIT NO.	KILOWATT CAPACITY	CONVERSION EFFICIENCY
1960	Unit 1	12,500 kw	14.6 %
1963	Unit 2	13,750 kw	14.9 %
1966	Unit 3	27,500 kw	14.8 %
1968	Unit 4	27,500 kw	14.8 %
1971	Unit 5	55,000 kw	16.3 %
	Unit 6	55,000 kw	
1972	Unit 7	55,000 kw	16.3 %
	Unit 8	55,000 kw	
1973	Unit 9	55,000 kw	16.3 %
	Unit 10	55,000 kw	
1975	Unit 11	110,000 kw	16.6 %

(Source: Personal Communication, Pac. Gas & Elec., 1977)

First Federal Lease Sale

After this area was classified as a KGRA for the existing Federal lands on the basis of overall geothermal indicia, the first Federal lease sale was held on January 22, 1974. Since this area was already within an "established" geothermal area of on-going commercial development, the resultant bids

received for those dozen Federal tracts was in excess of $10 million dollars -- with the highest single tract going for $3.2 million. The listing below reflects the high bids at that sale, the bidders, and the amount bid per acre:

THE GEYSERS FEDERAL LEASE SALE - JANUARY 22, 1974

TRACT NO.	BIDDER	TOTAL BID	BID/ACRE
1	Shell Oil	$3.2 million	$1,367.52/acre
2	Shell Oil	$1.3 million	$847.46/acre
3	Thermogenies	$22,050.00	$126.00/acre
4	Union Oil	$48,314.36	$478.36/acre
5	Union Oil	$80,842.84	$478.36/acre
6	Union Oil	$12,243.56	$5.11/acre
7	Union Oil	$318,120.68*	$508.18/acre
8	Signal Oil	$75,600.00	$302.40/acre
9	Occidental	$163,360.00*	$1,021.00/acre
10	Occidental	$226,662.00	$1,021.00/acre
11	Union Oil	$22,868.10	$508.18/acre
12	Signal Oil	$56,666.00	$76.89/acre

(* denotes bid rejected)

Appendix A (rear of report) shows each Federal lease, by number, and the corresponding bid/acre, with its relative placement at The Geysers in addition to the three Federal tracts currently being offered.

Current Status & Present Federal Lease Sale

At the present time, P.G. & E. provides 27% of its total power to both Lake & Sonoma counties, in which The Geysers area lies. This area is crossed by

several 60-kv lines distributed among several power substations located at Clear Lake, Konocti Geysers, Lower Lake, Middletown, Calistoga, and Geyserville. Concurrently, these counties consume less than 45% of the total power produced at The Geysers. Accordingly, P.G. & E. stands ready to accept any and all future geothermal-based power — either developed by a private firm and sold to P.G. & E. or utilizing P.G. & E. to develop power from any future steam recovery.

Three Federal tracts are presently being offered, and these tracts appear on Appendix A (rear of report). With respect to tract 2, the two Shell leases (i.e., CA-949 and CA-950) lie immediately north of this tract. Drilling on these tracts has resulted in varying steam flows from a low of 80,000 lbs/hr to a high of 185,000 lbs/hr. Additionally, this tract lies closest to the center of The Geysers field, and appears to have a potential in excess of either tract 1 or tract 3.

In order to ascertain fair market value for tract 2, a comparable value basis-of-calculation was used. In this method, several economic factors must be determined. We note, however, that any comparable value calculation is superior to any other "value determinations" (as ruled by court) with the exception of having a professional appraiser evaluate similar lands for sale. Thus, comparable value determinations always supercede any volumetric and/or discount-cash flow calculations.

To properly utilize this methodology, we determine what proportion of land lies conterminous to land with established value — specifically, Federal lease CA-949. Of the total 1203.81 acres in tract 2, only 120 acres fall into this category. The value of the CA-949 tract sold in 1974 constitutes a compound weighted average mean of all fair market bids submitted at that sale for that specific tract. Since the bids had a variance of $23,400 on the low side, to $3.2 million on the high side, the weighted mean (μ) is calculated to be $837,919.46, or approximately $338/acre. But this value is

for the original tract offered and sold in 1974, and therefore we must re-cast those 1974 dollars into 1977 dollars (as of date of this lease sale). To do this, we use the general consumer price index (CPI) — which inflates those dollars to $452/acre in current dollars.

Lastly, since the $452/acre value applies only to conterminous lands, and as only 120 acres lies precisely conterminous to tract 2 (see Figure 7), the resulting value for the entire tract 2 becomes $54,314 — or about $45/acre in 1977 dollars based upon comparable value calculations. Thus, as reflected in Appendix B (rear of report), our minimum acceptable fair market value of this tract is $45/acre.

Tract 1, which lies to the north and west of the center of The Geysers field, is felt by the evaluation committee to have very little geothermal potential within any reasonable drilling limit (to say, 10,000'). Due to the overall negative impact of available geophysics, we cannot ascribe anything but a nominal value to this tract, although it is the feeling of the committee that substantial bids will probably be received due to the feeling within private industry that lands generally within The Geysers area have some minimum economic potential, even without a proven resource to the northwest of the established field. The committee's expected range of industry bidding for all three tracts appears in Appendix B.

Tract 3 (a scant 80 acres) is presently seen to have no economic value due to its greater distance from the heart of the established field, and the geological/geophysical indications which appear at this date to remain largely negative. Thus the committee felt that the potential range of industry bidding will be far less than either of the other tracts being offered, and could possibly have very few (if any) bids whatsoever. A strictly nominal value for this tract is consistent with the committee's overall evaluation.

GEYSERS - CALISTOGA KGRA

FIG. 7

TRACT 2

N

SHELL LEASES

CA-950

CA-940

Pine Flat

0 1 2 km

scale

prepared by Rick Allen

U.S. GEOLOGICAL SURVEY
CONSERVATION DIVISION
WESTERN REGION

OFFICE OF THE
AREA GEOTHERMAL SUPERVISOR

CONCLUSION

The three tracts presently offered lie within the expanded Geysers-Calistoga KGRA, and as such border on the established Geysers geothermal field. There has been on-going commercial production from this area since 1960, and it is the committee's feeling that industry will continue to value this area much higher than other rank wildcat areas.

Based upon our own review and analysis of available informational sources, there appears to be positive potential for commercial geothermal development within tract 2 (despite existing restrictive stipulations), and a minimum acceptable fair market valuation of $45/acre (based upon comparable value determination) appears to be in order.

As noted in the Technical Supplement to this report, computer-based calculations were performed using the DCF model G of the GUESS system. These calculations resulted in an expected value of $25-$47/acre for tract 2, which is both supportive and consistent with the comparable value approach described herein. Tract 1 appears to have little (if any) commercial potential, and like tract 3, is valued strictly nominal.

Charlie Brook
Charlie Brook

Marvin Furman
Marvin Furman

Marshall Reed
Marshall Reed

William Isherwood
William Isherwood

Timothy J. MacGillvray
Tim MacGillvray

Jim Taylor
Jim Taylor

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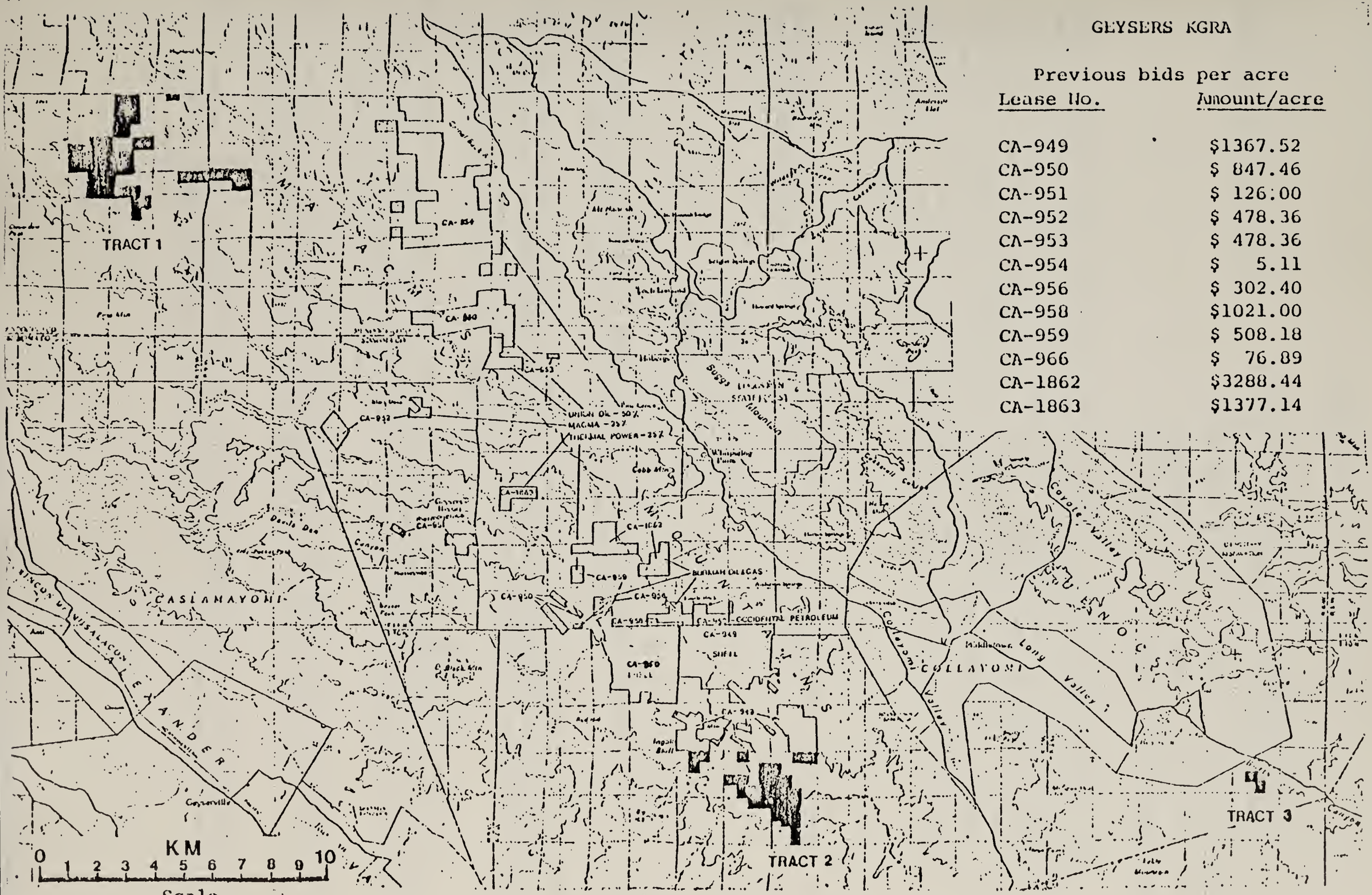
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APPENDIX A.

GEYSERS KGRA

Previous bids per acre

Lease No.	Amount/acre
CA-949	$1367.52
CA-950	$ 847.46
CA-951	$ 126.00
CA-952	$ 478.36
CA-953	$ 478.36
CA-954	$ 5.11
CA-956	$ 302.40
CA-958	$1021.00
CA-959	$ 508.18
CA-966	$ 76.89
CA-1862	$3288.44
CA-1863	$1377.14



Geysers-Calistoga KGRA lease tracts and adjacent Federal leases.

APPENDIX B

Tracts, In Rank Order	Minimum Acceptable Values	Expected Bidding Range
2	$45 per acre	$25 - $750 per acre
1	Nominal	$5 - $ 75 per acre
3	Nominal	$0 - $ 25 per acre

*Note: While the committee ranks tract 1 as being nominal in value, there remains a minimal chance that a commercially productive resource might be obtained through unusually fortunate drilling activities on this tract. That case, however, would present a total probability of approximately 10-15%. Tract #3 remains sufficiently inferior that the committee felt there may be some chance that no bids whatsoever would be forthcoming on that tract. Thus, our minimum expected bidding on this tract is zero -- that is, no bids.

The Geothermal Reliability Categories for The Geysers-Calistoga data are explained below.

Tract 1 = "B"
Tract 2 = "B"
Tract 3 = "D"

"A". Excellent geologic and geophysical information; production and cost data are reliable, reliable well information available.

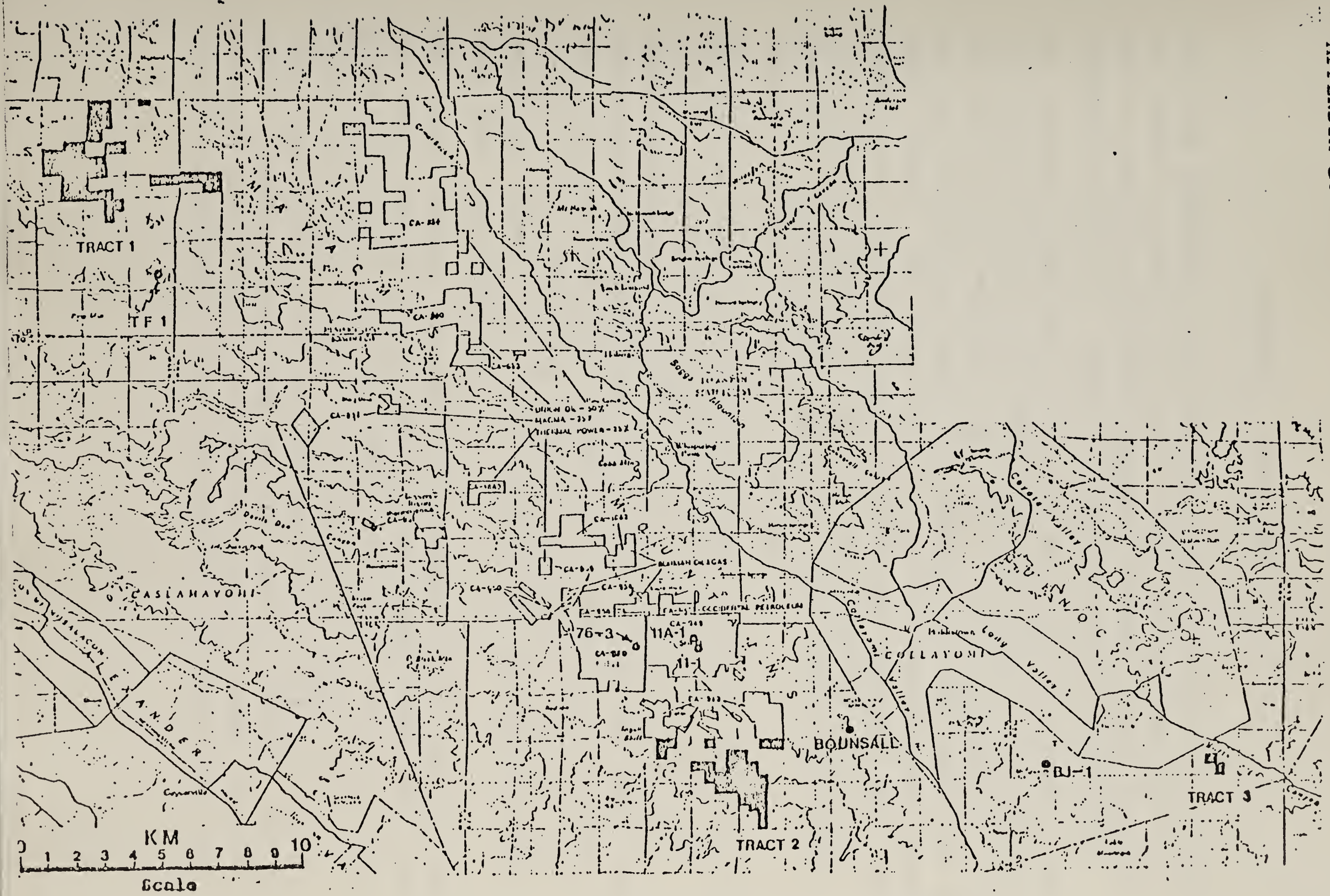
"B". Geologic data coverage is basically complete, geophysics may be available, production and cost data fairly reliable although productivity may be in error; well information available, although reliability or applicability of data may require some inference.

"C". Geologic and geophysical information may contain data gaps, but is in general, good. Production data requires much inference, such cost data may be fairly reliable; nearest well control is a distance from tract as to be only vaguely applicable.

"D". Geology is generalized; geophysics have data gaps, or is unreliable; well control sparse or only vaguely applicable, cost data weak, and production data lacking.

"E". Geology and geophysics may be either not available or very unreliable; no cost or production data for the area, broad inferences must be made; no well control.

APPENDIX C.


TRACT 1
TF 1
CA-811
CA-884
CA-880
CA-885
CA-883
CA-886
CA-887
CA-888
CA-889
CA-890
CA-891
CA-892
CA-893
CA-894
CA-895
CA-896
CA-897
CA-898
CA-899
CA-900
CA-901
CA-902
CA-903
CA-904
CA-905
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CA-907
CA-908
CA-909
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CA-911
CA-912
CA-913
CA-914
CA-915
CA-916
CA-917
CA-918
CA-919
CA-920
CA-921
CA-922
CA-923
CA-924
CA-925

TECHNICAL SUPPLEMENT

While the comparable value methodology was utilized to determine fair market valuation for Tract 2, other calculations were also made to approach the overall valuation question from a slightly different standpoint. These calculations are described below:

Two different GUESS Model G runs had been made using inputs from the committee members (see following three pages). This analysis used enthalpy and economic inputs for a single-well analysis, with its pro-rata share of costs (both capital costs and operations & maint. costs). With those inputs, plus all other relevant inputs listed on the following pages, two runs were completed which did yield positive values for Tract 2. These positive values were then input into the linear regression card (used in the HP-65) together with the alternative flow rates.

The flow rates chosen as most applicable were those experienced on CA-949 -- the immediately adjacent tract which was sold at the initial Geysers sale of 1974. Flow rates (in lbs/hr) on that tract are between 80,000 and 185,000 lbs/hr, with the lower value being largely attributed to poor drilling techniques (and thus a higher actual flow being normally attainable). The two "end" parameters however, were taken as given, and the discount cash-flow (DCF) runs completed.

The "graph" showing the regression analysis results reflects the fact that, despite the low flow rate of 80,000 lbs/hr (which was noted being poorly drilled), almost all values for Tract 2 were within the positive range -- and further that flows similar to those experienced on CA-949 would result in a long-run expected value of between $25-$47 per acre for Tract 2. This is felt to be highly supportive of the $45/acre figure per comp. value calculation as described within the Economics section of the text.

The following pages reflect the input listings and actual data used to generate dollar values for the data-input into the Linear Regression statistical card of the HP-65. This is done in the following manner:

(A). After the GUESS computer runs have been made (the input data of which is reflected on the following pages), a resultant dollar value must then be divided by the total number of acres (1203.81) for the specific tract (tract #2). Those inputs, as well as actual data, plus the total expected value at each flow rate is shown on the following pages. The expected value at 80,000 lbs/hr was $30,986, or $25.74/ac., while the value at 180,000 lbs/hr was $56,988, or $47.34/ac. for tract #2;

(B). These values (80,000 lbs/hr at $25.74 and 180,000 lbs/hr at $47.34) are then used as inputs as "X" and "Y" values for the linear regression program of the HP-65. In the analysis, the flow rates are the "X" values, and the dollar/acre values the "Y";

(C). The linear regression program takes the above values and, using the mathematical formula of

$$Y = mx + b$$

where y = the dependent variable
m = the slope of the resulting straight line
x = the independent variable
b = the value of y when x=0 (the "y-intercept")

calculates a least squares linear regression (i.e., it 'finds' the most accurate straight line to 'fit' the series of data points that have been previously calculated from the GUESS programs), and also provides a statistical test to determine the "goodness of fit" (or r^2 -- also called the coefficient of determination). If the data provided for this linear regression is actually a "perfect fit", then the r^2 will have a value of 1.0000 -- and all values projected from that data will lie exactly on that line. As we note on our graph, the r value is 1.0000.

(D). Since all values (both actual data and projections) lie on the line of our graph, we may accurately note that (1) the point where that line intersects the "X" axis is the point where the minimum flow will just exactly yield sufficient cash-flow to cover all costs of production. We see on our graph that this point is about 30,000 lbs/hr +, but with a 10% and 20% profit built-in, this line will shift parallel to the right, and (2) any lesser flows will result

in aggregate losses to the operator, and (3) that flow reates prevalent on CA-949 will yield positive cash flows if similar flows can be encountered on tract #2. Thus, the computer data generates the flow and dollar values needed for the inputs into the HP-65 program so that a basic mathematical regression equation may calculate the single line which best fits or explains all data projections.

There are other statistical tests which can be made using the programs of the HP-65, but for purposes of verifying tract valuation the linear regression is technically sufficient. Thus, with the Monte Carlo discount cash-flow features of the GUESS models, plus the statistical veracity supplied by the linear regression programs, we may note that this provides data computation backup for the comparable value approach used to determine acceptable value for tract #2 mentioned in the main text of this report.

```
CMNT J. KENNER , T. MAC GILLVRAY, AND E. BLAKLEY MODIFICATION G                  000000
CMNT GEOTHERMAL VERSION G OF 14 AUGUST 1978                                      000000
MODL        CALL CUMPOW(YR) ;                                                    000003
MODL        CALL MAXPOW (MXRW) ;                                                 000004
MODL        YEAR = YR + 1977 ;                                                   000005
CMNT  DECLINING RATE  YRPROD IS FIRST PRODUCING YR                               000006
MODL        RATE = RATE ;                                                        000007
MODL        IF(YR .LT. YRPROD)  RATE = 0       ;                                 000008
MODL        IF(YR .EQ. YRPROD )  RATE = RATE ;                                   000009
MODL        IF(YR .EQ.YRPROD+1)  RATE = RATE / (1 + DECL1)  ;                    000010
MODL       IF(YR .GT.YRPROD+1) CALL GETVAL(RATE,YRPROD+1,RATE,0 )  ;             000011
MODL        IF(YR .GT.YRPROD+1) RATE = RATE / ((1 + DECL) **                     000012
MODL         (YR - YRPROD - 1)) ;                                                000013
MODL           PRODRT = RATE * NUMWEL * (1. - RRISK)  ;                          000014
MODL           GROSS = (ENTIN - ENTOUT)  * .8 * EFFIC * PRODRT * MILLS           000016
MODL           * 8.640 / 3409.52  ;                                              000017
MODL           IF(PRODRT .EQ. 0) OPER = 0  ;                                     000018
MODL        SALES = GROSS - (ROYRAT * GROSS)  ;                                  000019
MODL        CCPW = (1. - XPSPCT) * PWELL * NUMWEL ;                              000020
MODL        CAPE = CAPI + CCPW  ;                                                000021
MODL        DIRE = XPSPCT * PWELL * NUMWEL + OPER  ;                             000022
MODL        CALL PREV(CAP,CAP,1,0) ;                                             000024
MODL        DEPR = 2*(CAP + CAPE) / YRDEPR  ;                                    000025
MODL        CAP = CAP + CAPE - DEPR  ;                                           000026
MODL        CFBT = SALES - DIRE - CAPE ;                                         000027
MODL        TINC = SALES - DEPR - DEPL - DIRE ;                                  000028
MODL        TAX = FIT * TINC ;                                                   000029
MODL        CFAT = TINC - TAX + DEPR + DEPL - CAPE ;                             000030
MODL        CALL PREV(R1,CUMFLB,1,0)  ;                                          000031
MODL        CUMFLB = R1 + CFBT ;                                                 000032
MODL        CALL PREV(R2,CUMFLA,1,0) ;                                           000033
MODL        CUMFLA = R2 + CFAT ;                                                 000034
MODL        CFAT1 = CFAT /1000   ;                                               000035
MODL        CALL PRWRTH (PV,DISC,CFAT1,0) ;                                      000036
MODL        IF (YR.NE.MXRW) GO TO 99  ;                                          000037
MODL        PVRISK = PV * (1. - XRISK) * WELLS - (XRISK) * (XPLOR)  ;            000038
MODL L(99)   END ;                                                               000039
RPRT   R       YR                                 -----          0              000040
RPRT   R       YEAR                YEAR           -----          0              000041
RPRT     T     ENTIN  ENTHALPY     INPUT          -----          0              000042
RPRT     T     ENTOUT ENTHALPY   EXHAUST          -----          0              000043
RPRT     T     RATE                LB/HR          -----          0              000044
RPRT     T     PRODRTPRODUCTIONRATE-L2/HR         -----          0              000045
RPRT     T     MILLS             MILLS/KWHR       -----          0              000046
RPRT     T     GROSS               GROSS          -----          0              000047
RPRT     T     SALES   GROSS-    ROYALTY          -----          0              000048
RPRT     T     PWELL PROD. WELL    COST           -----          0              000049
RPRT     T     CAPI  CAPITALIZD INVEST.           -----          0              000050
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RPRT     T     OPER  OPERATING EXPENSES           -----          0              000051
RPRT     T     CAPE  CAPITALIZD   COST           -----          0              000052
RPRT     T     DIRE  EXPENSED     COST           -----          0              000053
RPRT     T     CFBT  CASH FLOW BEFORE TAX        -----          0              000054
RPRT     T     DEPR              DEPRETIATN     -----          0              000055
RPRT     T     DEPL              DEPLETION      -----          0              000056
RPRT     T     TINC   TAXABLE    INCOME         -----          0              000057
RPRT     T     TAX                 TAX          -----          0              000058
RPRT     T     CFAT  CASH FLOW AFTER  TAX       -----          0              000059
RPRT     T     CUMFLBCUMULATIVECASH FLOWB       -----          0              000060
RPRT     T     CUMFLACUMULATIVECASH FLOWA       -----          0              000061
RPRT           CFAT1  CASH FLOW AFTER TAX        -----          0              000062
RPRT     S     PV     PRESENT    VALUE          -----          0              000063
RPRT     S     PVRISK P. VALUE     RISK          -----          0              000064
RPRT      T    WELLS                            -----          0              000064
END OF MODEL SECTION
```

```
DATA     30
TITL              GEYSERS-CALISTOGA KGRA -- TRACT #2 -- CALIFORNIA
TABL      1       MILLS          0.        0.        0.        0.        24.
TABL      2       MILLS         24.       24.       25.       25.        25.
TABL      3       MILLS         26.       27.       28.       29.        30.
TABL      4       MILLS         31.       32.       33.       34.        35.
TABL      5       MILLS         36.       37.       38.       39.        40.
TABL      6       MILLS         41.       42.       43.       44.        45.
TABL      1       PWELL          0.        0.      500.      250.         0.
TABL      2       PWELL          0.        0.        0.        0.         0.
TABL      3       PWELL          0.        0.        0.        0.         0.
TABL      4       PWELL          0.        0.        0.        0.         0.
TABL      5       PWELL          0.        0.        0.        0.         0.
TABL      6       PWELL          0.        0.        0.        0.         0.
TABL      1       OPER           0.        0.        0.       20.        20.
TABL      2       OPER          20.       20.       20.       20.        20.
TABL      3       OPER          30.       30.       30.       30.        30.
TABL      4       OPER          40.       40.       40.       40.        40.
TABL      5       OPER          47.       47.       47.       47.        47.
TABL      6       OPER          50.       50.       50.       50.        50.
TABL      1       CAPI           0.        0.        0.      250.       250.
TABL      2       CAPI           0.        0.        0.        0.         0.
TABL      3       CAPI           0.        0.        0.        0.         0.
TABL      4       CAPI           0.        0.        0.        0.         0.
TABL      5       CAPI           0.        0.        0.        0.         0.
TABL      6       CAPI           0.        0.        0.        0.         0.
PROB   C          DEPL         0.0
PROB   C          ROYRAT       .125
PROS   C          YRDEPR       30.
PROB   C          FIT          .48
PROB   C          NUMWEL       1.
PROB   C          XPSPCT       .66
PROB   C          YRPROD       4.
PROB   C          DECL1        .02
PROB   C          DECL         .01
PROB   C          EFFIC        .16
PROB   C          ENTIN        1194.
PROB   T          ENTOUT       200.      214.      240.
PROB   T          MILLS        1.0       1.33      1.50
PROB   T          PWELL        .50       .67       1.0
PROB   T          OPER         .67       1.0       1.50
PROB   T          CAPI         .67       1.0       1.25
PROB   C          RATE         80.
PROB   C          WELLS        1.
PROB   C          XRISK        .40
PROB   C          XPLOR        .25
PROB   C          RRISK        .04
PROB   C          DISC         .12
COMP       M
COMP       E
SENS               PV
SENS               PVRISK
MCLO       T       PV
MCLO       T       PVRISK
END
/*
//
```

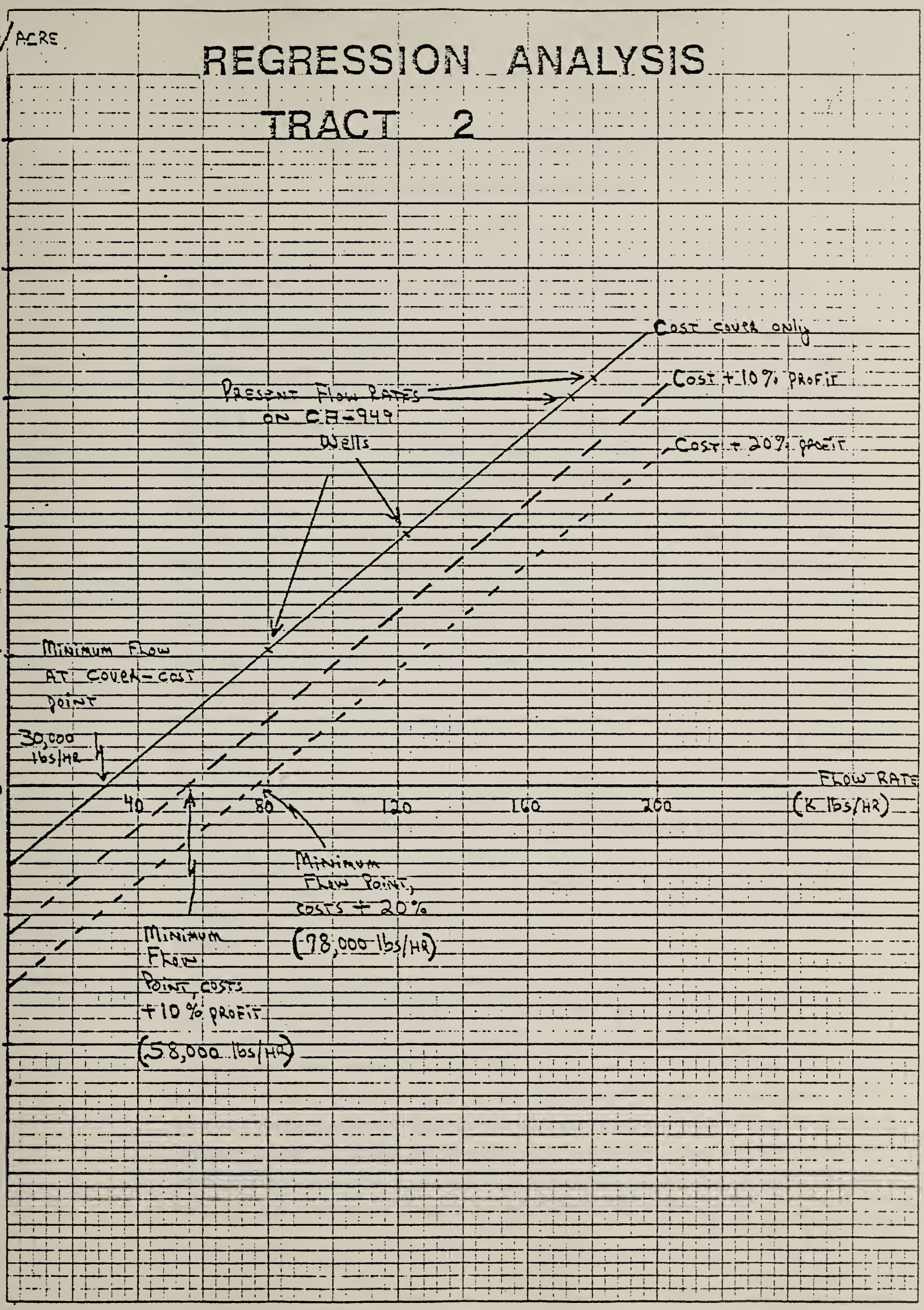
Expected Value = $30,986
÷ 1203.81 ac.
= $25.74/acre.

```
DATA      30
TITL              GEYSERS-CALISTOGA KGRA -- TRACT #2 -- CALIFORNIA
TABL      1       MILLS          0.      0.      0.      0.      24.
TABL      2       MILLS         24.     24.     25.     25.      25.
TABL      3       MILLS         26.     27.     28.     29.      30.
TABL      4       MILLS         31.     32.     33.     34.      35.
TABL      5       MILLS         36.     37.     38.     39.      40.
TABL      6       MILLS         41.     42.     43.     44.      45.
TABL      1       PWELL          0.      0.    500.    250.       0.
TABL      2       PWELL          0.      0.      0.      0.       0.
TABL      3       PWELL          0.      0.      0.      0.       0.
TABL      4       PWELL          0.      0.      0.      0.       0.
TABL      5       PWELL          0.      0.      0.      0.       0.
TABL      6       PWELL          0.      0.      0.      0.       0.
TABL      1       OPER           0.      0.      0.     20.      20.
TABL      2       OPER          20.     20.     20.     20.      20.
TABL      3       OPER          30.     30.     30.     30.      30.
TABL      4       OPER          40.     40.     40.     40.      40.
TABL      5       OPER          47.     47.     47.     47.      47.
TABL      6       OPER          50.     50.     50.     50.      50.
TABL      1       CAPI           0.      0.      0.    250.     250.
TABL      2       CAPI           0.      0.      0.      0.       0.
TABL      3       CAPI           0.      0.      0.      0.       0.
TABL      4       CAPI           0.      0.      0.      0.       0.
TABL      5       CAPI           0.      0.      0.      0.       0.
TABL      6       CAPI           0.      0.      0.      0.       0.
PROB   C          DEPL         0.0
PROB   C          ROYRAT       .125
PROB   C          YRDEPR       30.
PROB   C          FIT          .48
PROB   C          NUMWEL       1.
PROB   C          XPSPCT       .66
PROB   C          YRPROD       4.
PROB   C          DECL1        .02
PROB   C          DECL         .01
PROB   C          EFFIC        .16
PROB   C          ENTIN        1194.
PROB   T          ENTOUT       200.      214.      240.
PROB   T          MILLS        1.0       1.33      1.50
PROB   T          PWELL        .50        .67       1.0
PROB   T          OPER         .67       1.0       1.50
PROB   T          CAPI         .67       1.0       1.25
PROB   C          RATE         180.
PROB   C          WELLS        1.

PROB   C          XRISK        .40
PROB   C          XPLOR        .25
PROB   C          RRISK        .04
PROB   C          DISC         .12
COMP      M
COMP      E                                   Expected Value = $56,988
SENS              PV                                          1203.81 ac
SENS              PVRISK                                    = $47.34/acre.
MCLO      T       PV
MCLO      T       PVRISK
END
/*
//
```

REGRESSION ANALYSIS

TRACT 2



UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
STATE OFFICE
2800 Cottage Way
Sacramento, California 95825

GEOTHERMAL RESOURCES LEASE SALE

THE GEYSERS-CALISTOGA KGRA

CA 3870

1. Notice is hereby given that pursuant to the Geothermal Steam Act of December 24, 1970 (84 Stat. 1566; 30 U.S.C. 1011-1025), and the regulations issued thereunder, 43 CFR 3200, three leasing units, totaling 2,936.96 acres, within the Geysers-Calistoga Known Geothermal Resource Area in Lake, Mendocino, and Sonoma Counties, California, described in paragraph number six (6), are offered for geothermal leasing through SEALED BIDS to the responsible qualified bidders of the highest cash bonus for the privilege of leasing. All bids must be submitted to the office of the State Director, Bureau of Land Management, U.S. Department of the Interior, 2800 Cottage Way, Sacramento, California 95825, and must be received on or before 10:00 a.m. September 14, 1977; if submitted by mail, to Room E-2841, and if delivered in person, to Room E-2811. Bids received after 10:00 a.m. on September 14, 1977, will be returned unopened. Bids may not be withdrawn unless written withdrawal is received prior to 10:00 a.m. on September 14, 1977.

2. All bids must be submitted in accordance with the regulations in 43 CFR 3200 on Form 3200-4 or reproduction thereof. Separate bids must be submitted on each lease unit in a separate envelope and must be for the full unit described. The envelope in which the bid is submitted must be plainly marked that it is not to be opened before the date and hour set herein and must show the lease unit number and identify the Known Geothermal Resource Area. Bidder must submit with each bid one-half of the amount of the bid, in cash or by certified or cashier's check, bank draft, or money order made payable to the Bureau of Land Management; and statement of qualifications required by 43 CFR 3202. Bidders are warned against violation of 18 U.S.C. 1860 which prohibits unlawful combination or intimidation of bidders.

3. Bids will be opened and read at 11:00 a.m. on September 14, 1977, in Room W-1140 Federal Building, 2800 Cottage Way, Sacramento, California. The opening of the bids is for the purpose of publicly announcing and recording bids received and no bids will be accepted or rejected at that time. The deposits of the unsuccessful bidders will be returned by certified mail as soon as possible after the lease sale. The amount submitted with the high bids may be deposited in an unearned account in the Treasury during the period the bids are being considered. Such a deposit does not constitute and shall not be construed as acceptance of any bid on behalf of the United States. Any bonus bid considered as inadequate on the basis of the estimated

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AREA GEOTHERMAL SUPERVISOR'S OFFICE
CONSERVATION DIVISION

value of the lease will be rejected. The United States reserves the right to withdraw any tract from this sale prior to the issuance of a written acceptance of a bid and reserves the right to reject any and all bids. If the authorized officer fails to accept the highest bid for a lease within 30 days after September 14, 1977, all bids for that lease unit will be considered rejected. If there is any difference between the price per acre stated in the bid and the total amount of the bid, the total amount of the bid will govern. If the high bidder, after being notified that his bid has been accepted, fails to execute the lease or otherwise comply with the applicable regulations, his deposit will be forfeited and disposed of as provided in Section 20 of the Act and 43 CFR 3220.6(e).

4. Royalties payable to the United States will be at the rate of: (a) ten percent (10%) for Leasing Unit Nos. 1 and 3 and at the rate of twelve and one-half percent (12½%) for Leasing Unit No. 2 of the amount or value of steam or any other form of heat or energy derived from production; (b) five percent (5%) of the value of any byproduct derived from production except that as to any byproduct which is a mineral named in Section 1 of the Mineral Leasing Act of February 25, 1920, as amended (30 U.S.C. 181), the royalty for such minerals shall be the same as provided in that Act; (c) five percent (5%) of the value of commercially demineralized water sold or utilized by the lessee, except that no payment of a royalty will be required on such water used in plant operation for cooling or in the generation of electric energy or otherwise. Annual rental for the first through the fifth lease years will be at the rate of $2.00 per acre or fraction thereof; for the sixth lease year and for each year thereafter prior to production, the rental will be the amount of the rental for the preceding year, plus an additional $1.00 per acre.

5. Before issuance of a lease, the successful bidder will be required to submit (1) the balance of the bonus bid, (2) the first year's rental, (3) Forms 1140-7 and 1140-8 which contain the certification and information required by Executive Order 11246, as amended (41 CFR 60), and the plan required by 43 CFR 3210.2-1(d). A Nationwide Bond of $150,000, or a Statewide Bond of $50,000, or a general lease bond of $10,000 conditioned upon compliance with all the terms of the lease will be required prior to entry on the land.

6. Leasing units offered for bid are as follows:

Mount Diablo Meridian

California

Leasing Unit No. 1 — 1,653.15 acres

T. 12 N., R. 9 W.,
Sec. 7, N½SW¼ and SE¼.

T. 12 N., R. 10 W.,
Sec. 1, Lot 5;
Sec. 2, Lots 2 to 5, inclusive, Lots 8 to 10, inclusive, and SE¼SE¼;
Sec. 3, S½SE¼;
Sec. 10, Lots 1 to 10, inclusive, and Lots 15 to 18, inclusive;
Sec. 11, Lots 1, 2, and 4, and SW¼SE¼;
Sec. 12, Lots 7, 8, and 9;
Sec. 14, N½NE¼ and SW¼NE¼.

Leasing Unit No. 2 — 1,203.81 acres

T. 10 N., R. 7 W.,
Sec. 18, Lots 2 to 4, inclusive, N½NE¼, E½SW¼, and SW¼SE¼;
Sec. 19, N½ Lot 1, Lots 5 and 6, W½NE¼, E½NW¼, and W½SE¼.

T. 10 N., R. 8 W.,
Sec. 13, SE¼NE¼, NE¼NW¼, N½SW¼, SE¼SW¼, E½SE¼, and SW¼SE¼;
Sec. 14, NW¼NE¼ and E½NW¼;
Sec. 24, N½NE¼.

Leasing Unit No. 3 — 80.00 acres

T. 10 N., R. 6 W.,
Sec. 14, NE¼SW¼ and SW¼SE¼.

The land in this Notice is surveyed land described by legal subdivision, section, township, and range according to plats of survey now of record. Dependent resurveys are being executed under California Group 663 in the following townships involved in this Notice: T. 10 N., R. 7 W.; T. 10 N., R. 8 W.; and T. 12 N., R. 9 W., Mount Diablo Meridian. The descriptions in leases issued pursuant to this Notice will be conformed to the subdivisions of the resurveys and adjustment will be made in acreage and rental if and when the resurveys are approved for these townships.

7. The Lessee shall comply with the following special conditions and stipulations unless they are modified by mutual agreement of the Lessee, the Supervisor, and the Authorized Officer. In addition to the terms and requirements of the lease form and the special requirements of 43 CFR 3204, leases issued as a result of this sale will include the following special terms and conditions which have been developed to protect the environment, to permit use of the land for other purposes, and to protect other natural resources as set out in the Environmental Analysis Record of May 15, 1975, and the supplement thereto.

The following stipulations apply to each leasing unit.

1. Prior to the development of a Plan of Operations (43 CFR 3203.6 and 30 CFR 270.34), the Lessee shall contact the Supervisor and the Authorized Officer to review applicable regulations, GRO Orders, and special stipulations. This requirement may be waived in writing by the Authorized Officer and Supervisor after the lessee is thoroughly familiar with surface management problems and requirements for operations on the lease or for specific routine operations.

2. Plans of operation contemplating surface disturbing activities under this lease will include detailed reports of the cultural resources of the localities described in accordance with the requirements of 30 CFR 270.34 (a) – (e) and within 100 feet thereof. Such reports will include analyses of the significance of data recovered, and proposals for mitigation of the impacts of surface disturbing activities. Selection of archaeologists, design of data recovery programs, treatment of recovered materials, analyses of data and recommendation of mitigation measures, shall be in accordance with the guidelines of the Advisory Council on Historic Preservation (attached hereto). The authorized

officer shall submit for approval of the Supervisor plans of operation or portions thereof for which clearance has been gained as to mitigation required, including, as required, any specific sites for which surface disturbance shall be prohibited. The Supervisor and the lessee will be promptly notified by the Authorized Officer as to any actions taken by the State Historical Preservation Officer requiring consideration of proposed mitigation measures by the Advisory Council on Historic Preservation. The lessee will be given opportunity to be represented during any discussions between the Authorized Officer and the State Historical Preservation Officer, or before the Advisory Council.

3. The Lessee shall not disturb vegetation or soil closer than 700 feet horizontal from any perennial stream or closer than 50 feet horizontal from any intermittent stream except as otherwise authorized by the Supervisor and Authorized Officer.

4. Prior to plan of operation, the Lessee shall have a qualified botanist, acceptable to the Supervisor and the Authorized Officer, survey in detail the area proposed to be disturbed or occupied, together with an area not less than 100 feet wide surrounding each area to be disturbed or occupied, to discover the presence or absence of plants determined to be threatened or endangered pursuant to the Endangered Species Act of 1973. The Authorized Officer and the Supervisor may require that the survey extend through the full growing, flowering, and fruiting period of all threatened or endangered species which could be found within the survey area.

5. Roads constructed by the Lessee shall be available for joint use by other authorized users, including purchasers of Government timber. The Lessee and other users shall enter into road use and maintenance agreements satisfactory to the Authorized Officer prior to use of the roads by other users.

6. The Lessee shall not construct roads or pads between October 15 and March 15 of any winter season without prior written permission from the Authorized Officer and the Supervisor.

7. To insure stability of all geothermal facility construction sites, the Lessee will be required to conduct site-specific geotechnical investigations unless waived in writing by the Authorized Officer and Supervisor. The Supervisor and Authorized Officer may require that these investigations be conducted by a civil engineer knowledgeable in the practice of soil mechanics and/or a qualified engineering geologist; results of such studies will be submitted with and incorporated in the design. When any geothermal facility is to be sited on an identified landslide, a slope monitoring program acceptable to the Authorized Officer and the Supervisor will be required which will detect any slope movement that may occur. The installed slope monitoring devices may require monitoring throughout the life of the project, with the cost of installation and monitoring to be borne by the Lessee.

The following stipulation applies to Leasing Unit No. 1:

Because of steep slopes and unstable soils; the following described land is closed to all surface disturbing activities without the prior written approval of the Authorized Officer and Supervisor:

T. 12 N., R. 10 W., M.D. Mer.,
Sec. 10, Lots 1, 2, 5, 6, 7, 8, 9, 10, 15, and 16;
Sec. 11, Lots 1 and 2;
Sec. 12, Lot 9.

The following stipulations apply to Leasing Unit No. 2:

1. The Lessee will identify those trees which may be damaged or disturbed during Lessee's activities in advance of any operations. Trees of commercial value will be marked and appraised by BLM and the Lessee required to purchase at the BLM appraised price.

2. The following described area shall be closed to surface entry to protect the habitat of the Peregrine Falcon, Falco peregrinus anatum, an endangered species:

T. 10 N., R. 7 W., M.D. Mer.,
Sec. 18, N½NE¼, SW¼, SW¼SE¼;
Sec. 19, W½E½.

3. The Lessee shall design and locate all surface development within the view of the Mt. St. Helena overlook in a manner that preserves the natural appearance of the landscape from that point. Such development, in all cases, shall be blended into the natural environment by the use of landscaping, vegetative screening, compatible color schemes, minimum profile, and other landscape architectural techniques.

4. The Lessee shall construct all generation facilities and primary electrical transmission lines on the leased area which are located within the viewing area of the Mt. St. Helena overlook in a manner that preserves the natural appearance of the landscape from that point. In all cases where such facilities and lines are within the viewing area, they shall be blended into the natural environment by the use of landscaping, vegetative screening, compatible color schemes, minimum profiles, and other landscape architectural techniques.

8. Copies of forms and further information concerning this sale may be obtained from the Bureau of Land Management, Sacramento, California.

Walter F. Holmes
Chief, Branch of Lands
and Minerals Operations

Date: July 11, 1977

Guidelines for Making "Adverse Effect" and "No Adverse Effect" Determinations for Archaeological Resources in Accordance with 36 CFR Part 800

Archaeological properties included in or eligible for inclusion in the National Register of Historic Places are generally nominated under National Register Criterion "D" (36 CFR Part 60.6), which states that a property may qualify if it has "yielded, or may be likely to yield, information important in prehistory or history." While disturbance of archaeological properties should be avoided, under certain circumstances, properties primarily significant for the data they contain can be said to realize their significance when this data is retrieved in an appropriate manner.

In such cases where a Federal undertaking (36 CFR Part 800.3(c)) can result in the recovery of data from an archaeological property on or eligible for inclusion in the National Register of Historic Places, the Agency Official should take the following steps to decide whether a "no adverse effect" determination can be made:

> The Agency Official shall, in consultation with the State Historic Presevation Officer (SHPO), apply the criteria set forth in Part I below. If these criteria are not met, the Agency Official shall comply with the procedures set forth at 36 CFR Part 800.4(e) et seq. If the criteria are met, the Agency Official may issue a determination of no adverse effect for any data recovery program conducted in accordance with the requirements set forth in Part II below. Documentation that the criteria and requirements set forth in Parts I and II below have been met, along with the comments of the SHPO, shall be forwarded to the Council for review in accordance with 36 CFR Part 800.4(d).

Part I: Criteria

1. The property is not a National Historic Landmark, a National Historic Site in non-Federal ownership, or a property of historical significance so designated within the National Park System.
2. The SHPO has determined that in-place preservation of the property is not necessary to fulfill purposes set forth in the State Historic Preservation Plan.
3. The SHPO and the Agency Official agree that:
   a. The property (including properties that are subsidiary elements in a larger property defined in Criterion 1) has minimal value as an exhibit in place for public understanding and enjoyment;
   b. Above and beyond its scientific value, the property is not known to have historic or cultural significance to a community, ethnic, or social group that would be impaired by the retrieval of data;
   c. Currently available technology is such that the significant information contained in the property can be retrieved.
4. Funds and time have been committed to adequately retrieve the data.

Part II: Data Recovery Requirements

1. The data recovery will be conducted under the supervision of an archaeologist who meets the "Proposed Department of the Interior Qualifications for the Supervisory Archaeologist (Field Work Projects)." (See Attachment #1.)
2. The data recovery will be conducted in accordance with "Professional Standards for Data Recovery Programs." (See Attachment #2.)
3. A specified date has been set for completion and submission of the final report to the Agency Official.
4. Plans have been made for disposition of the material recovered after they have been analyzed for the final report. (See Attachment #3.)
5. Regarding the status of the affected property, documentation of the condition and significance of the property after data recovery will be provided the Agency Official and SHPO for forwarding to the National Register of Historic Places for action to include nominations, boundary changes, or removal of National Register or eligibility status, in accordance with National Register procedures (36 CFR Part 60.16 and 60.17).

ATTACHMENTS

Attachment #1 Proposed Department of the Interior Qualifications for the Supervisory Archaeologist (Field Work Projects)

The minimum professional qualifications for the Supervisory Archaeologist are a graduate degree in archaeology, anthropology, or a closely related field, or equivalent training accepted for accreditation purposes by the Society of Professional Archaeologists, plus: (1) at least sixteen months of professional experience or specialized training in archaeology field, laboratory, or library research, including (a) at least four months of experience in general North American archaeology, and (b) at least six months of field experience in a supervisory role; (2) a demonstrated ability to carry research to completion, usually evidenced by timely completion of thesis, research reports, or similar documents.

For work involving prehistoric archaeology, the Supervisory Archaeologist should have had at least one year of experience in research concerning archaeological resources of the prehistoric period.

For work involving historic archaeology, the Supervisory Archaeologist should have had at least one year of experience in research concerning archaeological resources of the historic period.

Attachment #2 Professional Standards for Data Recovery Programs

1. The data recovery program should be conducted in accordance with a professionally adequate recovery plan (research design):
   a. The plan shall be prepared or approved by the Supervisory Archaeologist and shall reflect a familiarity with previous relevant research;
   b. The plan shall include a definite set of research objectives, taking into account previous relevant research, to be answered in analysis of the data to be recovered;
   c. The plan shall provide for recovery of a usable sample of data on all significant research topics that can reasonably be addressed using the property or a justification for collecting data on a smaller range of topics at the expense of others;
   d. The plan shall specify and justify the methods and techniques to be used for recovery of the data contained in the property. (Methods destructive of data or injurious to the natural features of the property should not be employed if nondestructive methods are feasible.)
2. The data recovery program should provide for adequate personnel, facilities, and equipment to fully implement the recovery plan.
3. The data recovery program should insure that full, accurate, and intelligible records will be made and maintained of all field observations and operations, including but not limited to excavation and recording techniques, stratigraphic and/or associational relationships where appropriate, and significant environmental relationships.
4. Particularly when a data recovery program is conducted upon a potentially complex historic and prehistoric property (e.g., an historic townsite; a prehistoric site that may contain many occupation layers, cemeteries, or architectural remains), situations may arise or data be encountered that were not anticipated in designing the program. Adequate provision should be made for modification of the data recovery plan to cope with unforeseen discoveries or other unexpected circumstances.
5. The data recovery program should include provisions for dissemination of the results of the program. Generally, the final report should be made available to the SHPO, the State archivist, the State archaeologist, the Departmental Consulting Archaeologist of the Department of the Interior, and the Chairman, Department of Anthropology, Smithsonian Institution.

Attachment #3 Treatment of Recovered Materials

The recommended professional treatment of recovered materials is curation and storage of the artifacts at an institution that can properly insure their preservation and that will make them available for research and public view. If such materials are not in Federal ownership, the consent of the owner must be obtained, in accordance with applicable law, concerning the disposition of the materials after completion of the report.

LISTING OF INPUT DECK

```
CMNT J.. RENNER , T. MAC GILLVRAY, AND B. BLAKLEY MODIFICATION G                0000010
CMNT GEOTHERMAL VERSION G OF 14 AUGUST 1976
MODL        CALL CURROW(YR) ;                                                   0000030
MODL        CALL MAXROW (MXRW) ;                                                0000040
MODL        YEAR = YR + 1977 ;                                                  0000050
CMNT  DECLINING RATE  YRPROD IS FIRST PRODUCING YR                              0000060
MODL        RATE = RATE ;                                                       0000070
MODL        IF(YR .LT. YRPROD)  RATE = 0        ;                               0000080
MODL        IF(YR .EQ. YRPROD )  RATE = RATE ;                                  0000090
MODL        IF(YR .EQ.YRPROD+1)  RATE = RATE / (1 + DECL1)  ;                   0000100
MODL       IF(YR .GT.YRPROD+1) CALL GETVAL(RATE,YRPROD+1,RATE,0 )  ;            0000110
MODL        IF(YR .GT.YRPROD+1) RATE = RATE / ((1 + DECL) **                    0000120
MODL         (YR - YRPROD - 1)) ;                                               0000130
MODL           PRODRT = RATE * NUMWEL * (1 - RRISK)  ;                          0000140
MODL           GROSS = (ENTIN - ENTOUT)  * .8 * EFFIC * PRODRT * MILLS          0000160
MODL           * 8.640 / 3409.52  ;                                             0000170
MODL           IF(PRODRT .EQ. 0) OPER = 0  ;                                    0000180
MODL        SALES = GROSS - (ROYRAT * GROSS)  ;                                 0000190
MODL        CCPW = (1. - XPSPCT) * PWELL * NUMWEL ;                             0000200
MODL        CAPE = CAPI + CCPW  ;                                               0000210
MODL        DIRE = XPSPCT * PWELL * NUMWEL + OPER  ;                            0000220
MODL        CALL PREV(CAP,CAP,1,0) ;                                            0000240
MODL        DEPR = 2*(CAP + CAPE) / YRDEPR  ;                                   0000250
MODL        CAP = CAP + CAPE - DEPR  ;                                          0000260
MODL        CFBT = SALES - DIRE - CAPE ;                                        0000270
MODL        TINC = SALES - DEPR - DEPL - DIRE ;                                 0000280
MODL        TAX = FIT * TINC ;                                                  0000290
MODL        CFAT = TINC - TAX + DEPR + DEPL - CAPE ;                            0000300
MODL        CALL PREV(R1,CUMFLB,1,0)  ;                                         0000310
MODL        CUMFLB = R1 + CFBT ;                                                0000320
MODL        CALL PREV(R2,CUMFLA,1,0) ;                                          0000330
MODL        CUMFLA = R2 + CFAT ;                                                0000340
MODL        CFAT1 = CFAT /1000   ;                                              0000350
MODL        CALL PRWRTH (PV,DISC,CFAT1,0) ;                                     0000360
MODL        IF (YR.NE.MXRW) GO TO 99  ;                                         0000370
MODL        PVRISK = PV * (1. - XRISK) * WELLS - (XRISK) * (XPLOR)  ;           0000380
MODL L(99)   END ;                                                              0000390
RPRT   R       YR                              -----          0                 0000400
RPRT   R       YEAR                YEAR        -----          0                 0000410
RPRT     T     ENTIN  ENTHALPY      INPUT      -----          0                 0000420
RPRT     T     ENTOUT ENTHALPY     EXHAUST     -----          0                 0000430
RPRT     T     RATE                 LB/HR      -----          0                 0000440
RPRT     T     PRODRTPRODUCTIONRATE-LB/HR      -----          0                 0000450
RPRT     T     MILLS              MILLS/KWHR   -----          0                 0000460
RPRT     T     GROSS                GROSS      -----          0                 0000470
RPRT     T     SALES   GROSS-     ROYALTY      -----          0                 0000480
RPRT     T     PWELL PROD. WELL     COST       -----          0                 0000490
RPRT     T     CAPI  CAPITALIZD INVEST.        -----          0                 0000500
RPRT     T     OPER  OPERATING EXPENSES        -----          0                 0000510
RPRT     T     CAPE  CAPITALIZD     COST       -----          0                 0000520
RPRT     T     DIRE  EXPENSED       COST       -----          0                 0000530
RPRT     T     CFBT  CASH FLOW BEFORE TAX      -----          0                 0000540
RPRT     T     DEPR               DEPRETIATN   -----          0                 0000550
RPRT     T     DEPL               DEPLETION    -----          0                 0000560
RPRT     T     TINC   TAXABLE     INCOME       -----          0                 0000570
RPRT     T     TAX                  TAX        -----          0                 0000580
RPRT     T     CFAT  CASH FLOW AFTER  TAX      -----          0                 0000590
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RPRT      T     CUMFLBCUMULATIVECASH FLOWB-----                    0
RPRT      T     CUMFLACUMULATIVECASH FLOWA-----                    0
RPRT            CFATI  CASH FLOW AFTER TAX-----                    0
RPRT      S     PV     PRESENT    VALUE   -----                    0
RPRT      S     PVRISK P. VALUE    RISK    -----                    0
RPRT      T     WELLS                      -----                    0
END OF MODEL SECTION
DATA      30
TITL            GEYSERS-CALISTOGA KGRA -- TRACT =1 -- CALIFORNIA
TABL      1     MILLS          0.          0.          0.          0.         24.
TABL      2     MILLS         24.         24.         25.         25.         25.
TABL      3     MILLS         26.         27.         28.         29.         30.
TABL      4     MILLS         31.         32.         33.         34.         35.
TABL      5     MILLS         36.         37.         38.         39.         40.
TABL      6     MILLS         41.         42.         43.         44.         45.
TABL      1     PWELL          0.          0.        500.        250.          0.
TABL      2     PWELL          0.          0.          0.          0.          0.
TABL      3     PWELL          0.          0.          0.          0.          0.
TABL      4     PWELL          0.          0.          0.          0.          0.
TABL      5     PWELL          0.          0.          0.          0.          0.
TABL      6     PWELL          0.          0.          0.          0.          0.
TABL      1     OPER           0.          0.          0.         20.         20.
TABL      2     OPER          20.         20.         20.         20.         20.
TABL      3     OPER          30.         30.         30.         30.         30.
TABL      4     OPER          40.         40.         40.         40.         40.
TABL      5     OPER          47.         47.         47.         47.         47.
TABL      6     OPER          50.         50.         50.         50.         50.
TABL      1     CAPI           0.          0.          0.        250.        250.
TABL      2     CAPI           0.          0.          0.          0.          0.
TABL      3     CAPI           0.          0.          0.          0.          0.
TABL      4     CAPI           0.          0.          0.          0.          0.
TABL      5     CAPI           0.          0.          0.          0.          0.
TABL      6     CAPI           0.          0.          0.          0.          0.
PROB  C         DEPL         0.0
PROB  C         ROYRAT       .10
PROB  C         YRDEPR       30.
PROB  C         FIT          .48
PROB  C         NUMWEL       1.
PROB  C         XPSPCT       .66
PROB  C         YRPROD       4.
PROB  C         DECL1        .02
PROB  C         DECL         .01
PROB  C         EFFIC        .16
PROB  C         ENTIN        1194.
PROB  T         ENTOUT       200.        214.        240.
PROB  T         MILLS        1.0         1.33        1.50
PROB  T         PWELL        .50          .67         1.0
PROB  T         OPER         .67         1.0         1.50
PROB  T         CAPI         .67         1.0         1.25
PROB  C         RATE         180.
PROB  C         WELLS        1.
PROB  C         XRISK        .40
PROB  C         XPLOR        .25
PROB  C         RRISK        .04
PROB  C         DISC         .12
COMP      M
COMP      E
SENS            PV
SENS            PVRISK
MCLO      T     PV
MCLO      T     PVRISK
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0000600
0000610
0000620
0000630
0000640
0000650
0000660

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RPRT      T    CUMFLBCUMULATIVECASH FLOWB-----              0              0000600
RPRT      T    CUMFLACUMULATIVECASH FLOWA-----              0              0000610
RPRT           CFAT1  CASH FLOW AFTER TAX-----              0              0000620
RPRT      S    PV      PRESENT    VALUE   -----              0              0000630
RPRT      S    PVRISK P. VALUE    RISK    -----              0              0000640
RPRT      T    WELLS                      -----              0              0000645
END OF MODEL SECTION                                                       0000650
DATA      30
TITL           GEYSERS-CALISTOGA KGRA -- TRACT =1 -- CALIFORNIA
TABL      1    MILLS          0.          0.          0.          0.          24.
TABL      2    MILLS         24.         24.         25.         25.          25.
TABL      3    MILLS         26.         27.         28.         29.          30.
TABL      4    MILLS         31.         32.         33.         34.          35.
TABL      5    MILLS         36.         37.         38.         39.          40.
TABL      6    MILLS         41.         42.         43.         44.          45.
TABL      1    PWELL          0.          0.        500.        250.           0.
TABL      2    PWELL          0.          0.          0.          0.           0.
TABL      3    PWELL          0.          0.          0.          0.           0.
TABL      4    PWELL          0.          0.          0.          0.           0.
TABL      5    PWELL          0.          0.          0.          0.           0.
TABL      6    PWELL          0.          0.          0.          0.           0.
TABL      1    OPER           0.          0.          0.         20.          20.
TABL      2    OPER          20.         20.         20.         20.          20.
TABL      3    OPER          30.         30.         30.         30.          30.
TABL      4    OPER          40.         40.         40.         40.          40.
TABL      5    OPER          47.         47.         47.         47.          47.
TABL      6    OPER          50.         50.         50.         50.          50.
TABL      1    CAPI           0.          0.          0.        250.         250.
TABL      2    CAPI           0.          0.          0.          0.           0.
TABL      3    CAPI           0.          0.          0.          0.           0.
TABL      4    CAPI           0.          0.          0.          0.           0.
TABL      5    CAPI           0.          0.          0.          0.           0.
TABL      6    CAPI           0.          0.          0.          0.           0.
PROB   C       DEPL         0.0
PROB   C       ROYRAT       .10
PROB   C       YRDEPR       30.
PROB   C       FIT          .48
PROB   C       NUMWEL        1.
PROB   C       XPSPCT       .66
PROB   C       YRPROD        4.
PROB   C       DECLI        .02
PROB   C       DECL         .01
PROB   C       EFFIC        .16
PROB   C       ENTIN       1194.
PROB   T       ENTOUT       200.        214.        240.
PROB   T       MILLS        1.0         1.33        1.50
PROB   T       PWELL        .50          .67         1.0
PROB   T       OPER         .67         1.0         1.50
PROB   T       CAPI         .67         1.0         1.25
PROB   C       RATE         80.
PROB   C       WELLS         1.
PROB   C       XRISK        .40
PROB   C       XPLOR        .25
PROB   C       RRISK        .04
PROB   C       DISC         .12
COMP       M
COMP       E
SENS           PV
SENS           PVRISK
MCLO       T   PV
MCLO       T   PVRISK
```

REPU

REGRESSION ANALYSIS
TRACT #2

$/ACRE

60

45

30

15

0

-15

-30

-45

40 80 120 160 200 240

FLOW RATE (K lbs/HR)

PRESENT FLOW RATES ON CA-949 WELLS

MINIMUM ECONOMIC FLOW NEEDED ≈ 30,000 lbs/HR

$Y = -9.54 + 0.0003x$

$r^2 = 1.0000$

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

Conservation Division
345 Middlefield Road
Menlo Park, California 94025

November 21, 1974

Memorandum

To: Conservation Manager

Through: Area Geologist, Pacific Area

From: Geologist

Subject: KGRA Classification Standards

The recent filing of non-competitive lease applications and concomitant designation of competitive interest has caused a review of lands classified as KGRA's. The standards for classification set out in Circular 647 do not need revision for the indicia enumerated are as valid today as they were four years ago. However, the interpretation of them may need revision or, at least, more careful consideration.

The definition of a KGRA by the Geothermal Steam Act of 1970 is broad enough to include uses of the energy contained in geothermal fluids and formations for purposes other than generation of electrical power. Although most of the origina KGRA's were defined with expectation of power production, several, and most notably Klamath Falls, Oregon, were considered as areas suitable for space heating or other industri applications.

Economic and technical reasons require 200°C or hotter fluid for electrical production. Improved methods may allow utiliza tion of fluid as low as 170°C. However, even for the economic use of fluid in the range of 200° to 225°C a revenue of about 7 mil per kilowatt generated from the fluid appears to be necessary with present production and exploration costs. Fluids of considerably lower temperature may be useful for space heating or industrial processing. The lower limit may, in fact, be somewhat less than 50°C.

Obviously, heating applications cannot be disregarded in KGRA definitions, but, can all lands which have geologic characteristics suitable for non-electrical generation uses be classified as KGRA? I would hope that the answer is "NO"! Site location and its influence on economic utilization should be fully considered. Since the act talks about competitive interest, discoveries, and experienced men expending money, the Congress assuredly wants consideration of economic factors in KGRA definitions.

Therefore, in defining a KGRA all the geologic and engineering data should be examined and the likely reservoir temperature, extent, and producibility of the system should be determined. With this information a preliminary decision as to whether or not electrical production is possible can be made. If an estimated reservoir temperature in excess of about 150°C cannot be established, the lands should not be defined as KGRA unless the location and characteristics of the geothermal system are such that some use other than electrical production can be made of the fluids. Other factors bearing on the economics, such as depth of wells, rate of fluid production, and market value of the product, are more difficult to account for, but should be considered

Areas in which geothermal fluids are already being utilized should certainly be reviewed for KGRA status. The most notable of these is the commercial use of hot water in a section of Boise, Idaho for home heating.

cc: Geothermal Supervisor

Conservation Division
Area Geologist's Office
345 Middlefield Road
Menlo Park, California 94025

February 10, 1975

Memorandum

To: Conservation Manager, Western Region

From: Area Geologist, Pacific Area

Subject: Request for clarification of policy regarding KGRA establishment

There may or may not be a contradiction between (1) what a KGRA is defined to be by the regulations and (2) our present procedure which requires that KGRAs be established anywhere that competitive interest exists. It may be prudent to seek the Solicitor's opinion in this matter.

The definition of a KGRA is "an area in which geology, nearby discoveries, competitive interests...would in the opinion of the Secretary engender a belief in men who are experienced in the subject matter that prospects for extraction...are good enough to warrant expenditures..."

The question that needs to be answered in writing is: Does this mean that anytime competitive interest, as defined by the regulations, exists, this fact alone and in every case, "in the opinion of the Secretary, would engender a belief...that prospects...are good enough to warrant expenditures...", and therefore a KGRA must be established?

We are currently proceeding under an oral policy that the Secretary so believes, but, to prevent possible Survey embarrassment, I would like to have the policy stated in writing because the Area Geologists and Regional Managers, Conservation Division are probably more acutely aware than anyone that some KGRAs currently being established probably would neveryqualify under a strict interpretation of that definition. Basically, it seems to be a question of just how liberal the Secretary's opinion is in this matter. But we do need something in writing for policy guidance.

Enclosed is a memo from Joel Renner who feels that unless reservoir temperatures in excess of about 150°C are expected, the lands should

not be made a KGRA (unless the location and characteristics of the system are such that uses other than production of electricity are truly viable development alternatives).

Our policy on revocation of KGRAs should also be set forth in writing, as the regulations are apparently silent on this matter. At the moment, we are not revoking any, although there are certainly several areas where a strong case could be made for revocation (areas where strongly negative information has come to light after the KGRA was established).

Henry L. Cullins

HLC/jv

cc: Cullins
Area Geothermal Supervisor

File: Geothermal 5-0

UNITED STATES
DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY
Conservation Division
345 Middlefield Road
Menlo Park, California 94025

February 11, 1975

Memorandum

To: Western Area Geothermal Supervisor
Pacific Area Geologist

From: Acting Conservation Manager, Western Region

Subject: Geothermal Tract Selection and Parcelling Procedures for KGRA Sales

The responsibility for geothermal lease sale tract selection and parcelling is hereby assigned to the Lease Sale Committee appointed from the Area Geothermal Supervisor's office and the Area Geologist's office. The committee shall provide the necessary information on tract selection and recommend parcelling for KGRA sales.

Preliminary geologic data shall be gathered and evaluated for tract parcelling by the respective member(s) of the Area Geologist's staff on the Lease Sale Committee. The primary responsibility for the initial tract parcelling (blocking) should normally lie with the Lease Sale Committee member from the Area Geologist's staff. The committee members from the Area Geothermal Supervisor's staff shall then offer expertise related to operational considerations which may influence or modify the blocking.

The results of the tract parcelling shall be transmitted by the Lease Sale Committee through the Area Geologist and the Area Geothermal Supervisor to the Conservation Manager. This transmittal shall include a memorandum from the Manager to the appropriate BLM State office with the appropriate information for inclusion in the sales notice similar to the guidelines in CDM Part 641.1A.3C.

If you have any problems with this procedure, please let us know.

Hillary A. Oden

RECEIVED
FEB 13 1975
Conservation Division
U.S. GEOLOGICAL SURVEY
Office of the Area Geologist
Pacific California

Conservation Division
345 Middlefield Road
Menlo Park, California 94025

February 12, 1975

Memorandum

To: Bob Conover, Field Solicitor's Office, Riverside, Calif.

From: Acting Conservation Manager, Western Region

Subject: KGRA Definition Problems

Enclosed is a copy of a memo from our Pacific Area Geologist on the subject. We have much empathy with his position since the regulations leave much to be desired and written "policy guidance" is conspicuous by its absence.

We would appreciate your written opinion on the following questions.

1. Do the regulations infer or allow the formal establishment of a KGRA by the Geological Survey based solely on "competitive interest" as defined and discussed under 43 CFR Part 3200.0-5(k)(3).

2. Do you foresee any legal bar or complications in revocation of all or parts of KGRA's (established either by "competitive interest" or on a geologic basis), whenever information is gained which indicates that the geology is negative or that competitive interest no longer exists? A recent case in point is a "competitive interest" KGRA in Arizona which received no bids at a lease sale and our geologic information does not support a reason for retaining the KGRA.

We may be asking sensitive questions but, as Mr. Cullins points out, we would like someone to share the blame for our actions if they later prove to be incorrect.

Hillary A. Oden

Hillary A. Oden

Enclosure

UNITED STATES
DEPARTMENT OF THE INTERIOR
OFFICE OF THE SOLICITOR
3610 CENTRAL AVENUE. SUITE 104
RIVERSIDE. CALIFORNIA 92506

RECEIVED
U.S. Geological Survey
MAY 9 1975
Conservation Division
Western Region
Menlo Park, Calif.

May 7, 1975

Memorandum

To : Conservation Manager, Western Region, U.S. Geological Survey

From : Acting Field Solicitor, Riverside

Subject: KGRA Definitions Problems: Geothermal Steam Regulations

This refers to your memorandum of February 12, 1975, which requested our opinion regarding the requirements of 43 CFR Part 3200.0-5(k)(3) of the Geothermal Steam regulations respecting the establishment of KGRA's based solely on competitive interest.

It is our opinion that the requirements of the foregoing regulation not only allow the formal establishment of a KGRA by the Geological Survey based solely on competitive interest but also under the present policy of the Department of the Interior, which was made clear at the time of the promulgation of the regulation, a KGRA must be established if such "competitive interest" is present.

Secondly, we are of the opinion that there is no specific legal barrier to your revocation to all or part of a KGRA whether established by "competitive interest" or on a "geologic basis" whenever information is gained, such as no bids at a lease sale, that indicates that the geology is negative or that the competitive interest no longer exists. However, it should be pointed out that under the regulation the simple withdrawal or rejection of an overlapping lease application will not serve to prevent an area from being a KGRA.

Robert D. Conover
Acting Field Solicitor

cc: Associate Solicitor, Energy & Resources
Attn: Assistant Solicitor, Minerals
Geothermal Supervisor, U.S.G.S., Menlo Park
State Director, BLM, Sacramento Attn: 931

UNITED STATES
DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY
Conservation Division
Area Geologist's Office
345 Middlefield Road
Menlo Park, California 94025

February 10, 1976

Memorandum

To: Area Geologist, Pacific Area

From: Geologist, Menlo Park

Subject: Geothermal classification and statistics maps

I would like to remind you of the importance of making some policy decisions concerning our geothermal classification and statistics maps. With the beginning of the new calender year we have the opportunity to start fresh on this endeavor and decisions should be made before 1976 material starts coming in and is recorded "as usual." Listed below for your consideration are several suggestions concerning this subject:

1. We should hire a part time PSA to maintain classification maps and plot statistics for all leasable minerals including geothermal.

2. Classification and statistical records should be uniform for all states on an official basis, but individuals with state responsibiliti should be able to elect different recording systems to be maintained by them.

3. Every state should have available a 1:500,000 base map showing areas valuable prospectively and KGRA's. This map, perhaps with the temperatures taken off, should be the only map available for public distributi

4. The 1974 paper maps and the 1974-75 mylar maps showing lease applicatio should be relegated to historic status. 1976 applications should be plotted on a paper copy of the base map and maintained on a year by year basis. This is the map we should clear list off.

5. Each state should start an issued lease map showing all issued leases a showing the locations of deep drilling tests. This information would be plotted on a paper copy of the base map.

6. Circulate, but do not plot pre and post lease notice of intents.

7. Stop circulating BLM lease decisions.

With these suggestions at hand perhaps you could convene a short meeting in your office of those individuals concerned with geothermal and this subject could be discussed further.

Edward Johnson

Edward Johnson

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
Conservation Division
Area Geologist's Office
345 Middlefield Road
Menlo Park, California 94025

February 20, 1976

Memorandum

To: All Menlo Park Geologists
Helene Thury

From: Area Geologist, Pacific Area

Subject: Staff meeting, geothermal

Attached is a memo from Ed Johnson. I, too, have concerns about this matter.

Therefore, I request that each of you review Ed's suggestions and plan to meet with me at 9:30 a.m., February 25, to discuss what should be done to improve the present system.

Henry L. Cullins

Henry L. Cullins

Attachment

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
Conservation Division
Area Geologist's Office
345 Middlefield Road
Menlo Park, California 94025

March 1, 1976

Memorandum

To: All Geologists, Office of the Pacific
Area Geologist, Menlo Park

From: Area Geologist, Pacific Area

Subject: APDs, Reviews of APDs, and Notices of Completion for Geothermal Wells on Federal Leases

We are preparing a binder in which to file APDs, our reviews of APDs, and notices of completion for geothermal wells on Federal leases. This will serve manifold purposes: (1) it will give us a convenient reference file on Federal geothermal well locations; (2) it will furnish us the well status and other well information; and (3) it will serve to alert us to possible problems for nearby wells. The binder will be kept in the file cabinet under Geothermal 9, and the secretaries will be responsible for the filing. The APD, our review, and notice of completion for each well will be treated as a single package and filed in the following manner similar to our "locatable minerals" card files:

State (alphabetical)
(Meridians for California)
Township, Range, and Section in
increasing order and in the
sequence NE, NW, SW, SE

Because our records are far from complete, each geologist with state responsibility is requested to compile copies of APDs, reviews (if completed by this office), and notices of completion for all Federal geothermal wells in his state. We may have to obtain much of this information from the files of the Area Geothermal Supervisor (after his move).

Henry L. Cullins

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
Conservation Division
Area Geologist's Office
345 Middlefield Road
Menlo Park, California 94025

March 4, 1976

Memorandum

To: All Menlo Park Personnel

From: Area Geologist, Pacific Area

Subject: Geothermal classification and statistics maps

This memorandum is a follow-up to our meeting on Wednesday, February 25, when we discussed what should be shown on our state geothermal maps.

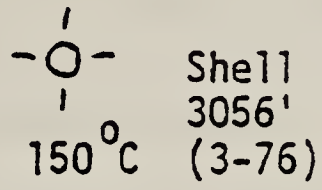
After due consideration, I've decided against requiring each state to maintain an issued lease map, but to continue to maintain our applications map, color coded by month on a paper print for each year. At the end of each year, that year's applications will be transferred to a mylar showing all lease applications for past years and the paper print relegated to historical status. A new paper print then will be started for the new year and that, in turn, will be relegated to the historical file at the end of that year. Competitive interest areas are also plotted on these maps. The primary use of this map is to focus our attention where competitive interest dictates KGRA establishment or where applications indicate that a revision of our prospectively valuable maps may be in order.

We intend to stop circulating BLM decisions. Therefore, we will no longer be required to erase withdrawn or denied applications.

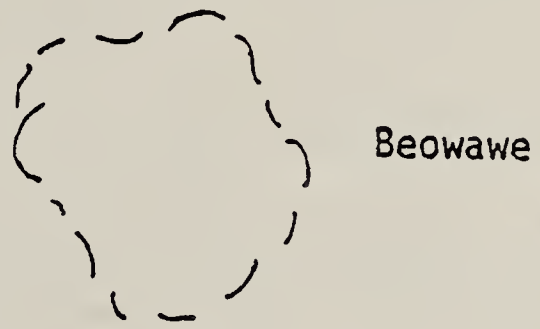
As to what geothermal maps should be maintained using our state 1:500,000 scale bases, I am requesting that all states continue to maintain the KGRA-Valuable Prospectively (KGRA-VP) maps on mylar. This map is available for public distribution according to our established procedures. This map will not show applications. In addition, I request that for all states, a dry hole and field map be prepared and maintained. This map should use the KGRA-VP map as a base and show all "wildcat" wells (wells drilled more than 1 mile from areas of previous drilling) and outlines of areas of concentrated drilling. This exploratory

well map is not meant to contain the myriad of shallow holes drilled by truck mounted rigs (such as a Failing 1500) unless such tests are significant for some reason.

In general, the well location will be shown by a symbol along with operator name, total depth, date started, and temperatures where known, i.e.



The area of concentrated drilling activity would be shown by dashed lines and a name, i.e.,



In the case of California, certain additional modifications of this approach may be necessary.

In summary, each state will have 3 types of geothermal maps using 1:500,000 scale state bases.

These are:
1) KGRA-VP map (mylar).
2) KGRA-VP map w/wildcat well locations and field outlines (mylar).
3) Application and competitive interest map (paper and mylar).

We will continue to circulate pre- and post-lease notices of exploration, but there is no need to plot these notices.

Backfilling of Hamlett's position has been approved, so we are proceeding to acquire additional cartographic help.

Henry L. Cullins

United States Department of the Interior

GEOLOGICAL SURVEY
RESTON, VIRGINIA 22092

APR 15 1976

Memorandum

To: Director, Bureau of Land Management

Through: Assistant Secretary--Energy and Minerals
Assistant Secretary--Land and Water Resources

From: Acting Director, Geological Survey

Subject: Reclassification of Known Geothermal Resource Area Lands

In order to alleviate the situation under the current acreage limitation of 20,480 acres (8,288.14 hectares) in any one State and to accelerate geothermal exploration, it is suggested that certain Known Geothermal Resource Area (KGRA) lands be reclassified. As you are aware, companies interested in forming exploration units are unable to depend upon acquisition of Federal lands subject to competitive leasing to complete a logical unit. The ability to file applications on lands no longer subject to the competitive overlap provision will allow more active participation in the geothermal energy development program by industry and will provide stimulus for investigation of possible low temperature utilization.

Classification actions resulting in the designation of KGRA's under the Geothermal Steam Act of 1970, Sec. (2e), and the Geothermal Leasing Regulations use competitive interest to place acreage within a KGRA. This process provides bonus money to the Government and tends to encourage development of the leases because of the investment required to obtain them. However, KGRA lands in this category which receive no bid in two successive lease sales have demonstrated a lack of competitive interest and should receive consideration for removal from the KGRA unless their retention can be justified by geothermal indicia. Moreover, lands included within a KGRA on competitive interest alone should be so designated on the KGRA plat. These lands, upon being evaluated as "nominal" by GS and receiving no bid at two successive lease sales, should then be subject to reevaluation and reclassification as valuable prospectively for geothermal resources. (This may require an addition to the existing leasing regulations under subpart 3200.0-5 (k)(3).)

We propose that a joint BLM-GS committee be set up to look into this problem and recommend solutions which will result in a planned reduction in KGRA acreage. Two additional reclassification categories should also be established under the reduced acreage scenario: (1) lands now within a KGRA

boundary which have been evaluated as "nominal" by the GS and have not been selected to be offered for lease following two scheduled lease sales in the area should be subject to reclassification as valuable prospectively for geothermal steam and (2) lands which will be designated as KGRA in the future on the basis of geoscientific data and are subsequently evaluated as "nominal" should be reoffered at no more than one lease sale following the sale in which either (a) the tract received no bids or (b) the bids were rejected as inadequate. Unleased land in this category should then be subject to reevaluation and reclassification as valuable prospectively for geothermal resources.

Should reclassification of KGRA lands be implemented, precautions should be taken to prevent such lands, especially those subject to a 50% overlap provision, from being returned to a KGRA without new and compelling geoscientific evidence to do so. Lands removed from a KGRA and reclassified should be offered for lease by BLM on the lottery system as provided in the Geothermal Steam Act for noncompetitive leasing.

We believe that the foregoing suggestions for reducing acreage presently within the defined limits of KGRA's deserve your attention. Please forward your comments and suggestions concerning a joint BLM-GS committee on the subject at an early date.

W. A. [illegible]
Acting Director

cc: AS-E&M(2) AS-L&W Dir. chron--MS114 EGS Gen--MS114
CD file--MS640 ADC/RE--MS640 C/BOE--MS640 LC/MFS MS640
RE chrons--MS640

CD:WHHowe:jlm:3/3/76
REWRITTEN:WHHowe:jlm:3/10/76
RETYPED:jlm:3/12/76

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
Area Geothermal Supervisor's Office
Conservation Division, MS 92
345 Middlefield Road
Menlo Park, CA 94025

RECEIVED
U.S. Geological Survey
JUN 14 1976

JUN 14 1976

Conservation Division
Western Region
Menlo Park, Calif.

Memorandum

To: Acting Conservation Manager, Western Region
Conservation Manager, Central Region
Conservation Manager, Eastern Region

From: Area Geothermal Supervisor

Subject: Memorandum of Understanding among USGS-BLM-USFWS for the Geothermal Program

Attached hereto for your information and files is a copy of subject MOU effective June 7, 1976 which sets forth cooperative procedures in the geothermal program among the indicated agencies.

This MOU is in accordance with SO 2948 and supercedes all other cooperative procedures in the geothermal program.

This is an advance copy preceding a formal Division release and instruction memorandum that I assume will be forwarded shortly.

Attachment

cc: Chief, Conservation Division
ERDA (Attn: Dana Kilgore)
DGS, Salt Lake City, Utah
DGS, Portland, Oregon
DGS, Reno, Nevada

RECEIVED
JUN 16 1976
Conservation Division
U.S. GEOLOGICAL SURVEY
Menlo Park, California

MEMORANDUM OF UNDERSTANDING

FOR THE GEOTHERMAL PROGRAM

U. S. GEOLOGICAL SURVEY - BUREAU OF LAND MANAGEMENT -

U. S. FISH AND WILDLIFE SERVICE

COOPERATIVE PROCEDURES IN THE GEOTHERMAL PROGRAM

TABLE OF CONTENTS

Introduction 1

1. Priorities and Scheduling of Lease Sales and Non-competitive Leasing 2

   a. Competitive Lease Sale Scheduling 2

   b. Scheduling for Non-competitive Leasing 2

2. Environmental Analysis Considerations 3

   a. Pre-Lease Environmental Analysis Record (EAR) 3

   b. Post-Lease Environmental Analysis (EA) 4

3. Competitive Lease Sales 4

4. Non-competitive Lease Applications 6

   a. Serial Register Page 6

   b. Competitive Interest Overlaps 7

   c. Environmental Considerations 7

   d. KGRA Clear Listing - Lease Issuance 8

5. Pre-Lease Exploration Permit 8

6. Post-Lease Notice of Intent to Conduct Geothermal Resource Exploration Operations 9

7. Plan of Operation and Application for Permit to Drill (APD) 9

8. Plans of Operation for Surface Installations or Subsequent Well Work 12

9. Plans of Development, Injection, or Production 12

10. Designation of Operator 12

11. Filing and Termination of Bonds 13

12. Relinquishments 13

13. Annual Environmental Report 13

14. Annual Report of Diligent Exploration 13

15. Designation of Coordinating Offices for Purposes of the Memorandum 13

16. General Provisions 14

MEMORANDUM OF UNDERSTANDING
FOR THE GEOTHERMAL PROGRAM

U. S. GEOLOGICAL SURVEY - BUREAU OF LAND MANAGEMENT -
U. S. FISH AND WILDLIFE SERVICE

The following guidelines are for the mutual cooperative efforts of the U. S. Geological Survey, Bureau of Land Management, and U. S. Fish and Wildlife Service in implementing the Federal geothermal resources program pursuant to the Geothermal Steam Act of 1970.

Abbreviations used hereafter for the various agencies, offices, and reports are as follows:

BLM	-	Bureau of Land Management
BLM-DO	-	Bureau of Land Management District Office
BLM-SO	-	Bureau of Land Management State Office
GS	-	U. S. Geological Survey
GS-RCM	-	U. S. Geological Survey, Regional Conservation Manager
AGS	-	Area Geothermal Supervisor
GS-AG	-	U. S. Geological Survey Area Geologist
GS-DG	-	U. S. Geological Survey District Geologist
FWS	-	Fish and Wildlife Service
FWS-RO	-	Fish and Wildlife Service Regional Office
FWS-AO	-	Fish and Wildlife Service Area Office
EAR	-	Environmental Analysis Record (prepared by BLM)
EA	-	Environmental Analysis (prepared by GS)
GEAP	-	Geothermal Environmental Advisory Panel (Sec. Order 296

1. Priorities and Scheduling of Lease Sales and Non-Competitive Leasing.

(Primary responsibility - BLM)

Primary contacts will be the AGS, the FWS-RO, the BLM-SO involved.

(a) Competitive Lease Sale Scheduling.

BLM-SO may on its own motion, on recommendation from GS, or through nominations from industry, select areas for and schedule competitive lease sales in Known Geothermal Resource Areas (KGRA's). The BLM-SO will consult with GS-RCM as to KGRA leasing priorities, recommendations for lease stipulations, total area to be covered by the EAR, and overall priority and scheduling of the EAR and the sale. The BLM-SO will consult with FWS-AO and RO concerning fish and wildlife resources and related habitat, and regarding recommended stiputations and mitigating measures to protect these resources.

Generally, the areas to be covered by the EAR, prepared by BLM-DO, should include the maximum number of non-competitive lease applications in the vicinity of the KGRA. Determination of priority of scheduling lease sales will generally be based upon the geothermal potential of the area, its environmental sensitivity, and industry, interest. If nominations are either solicited or received from industry, BLM-SO will send an information copy of nominations to AGS, Menlo Park, and the FWS-AO.

(b) Scheduling for Non-Competitive Leasing.

Where non-competitive leasing only is involved, BLM-SO should consult with AGS and FWS-RO to determine area, priority, and scheduling

of EAR's. Where withdrawn lands are involved, the BLM-SO shall consult with the appropriate land management agencies with the basic authority to permit leasing. The criteria for scheduling of EAR's to be prepared by the BLM-DO should include geothermal potential of the area, its environmental sensitivity, and industry interest. AGS will furnish, upon request by BLM-SO, a priority listing of potential geothermal areas with copies to the FWS-RO.

2. Environmental Analysis Considerations

(a) Pre-Lease Environmental Analysis Record (EAR). (Primary responsibility - BLM)

(1) Upon initiation or revision of an EAR for either competitive or non-competitive leasing, BLM-DO will notify in writing the AGS and the FWS-AO of the area covered by the EAR. The AGS and FWS-AO will furnish BLM-DO with technical advice and information for consideration in the EAR, including recommended stipulations and mitigating measures. BLM-DO should specify deadline for such input with a minimum of 30 days advance notice. Maximum lead time should be provided

(2) BLM-DO will furnish a copy of the draft EAR, with proposed special lease stipulations, to the AGS and FWS-AO and FWS-RO for review and comments prior to submission of EAR to BLM-SO.

(3) BLM-SO will furnish AGS the final BLM stipulations which are to be attached to non-competitive leases, or included in the notice of competitive lease sale, for the AGS review and concurrence with the stipulations. FWS-RO will be furnished a copy of the stipulations for review and comment.

(4) BLM-SO will furnish AGS and FWS-RO with two copies each of the final EAR.

(b) Post-Lease Environmental Analysis (EA). (Primary responsibility - AGS)

(1) For each proposal which requires a Plan of Operations, an Environmental Analysis (EA) will be prepared by the AGS. The AGS will request the technical advice on fish and wildlife matters, surface management, and environmental expertise of the BLM-SO and FWS-AO. The FWS-AO and the BLM-SO will provide technical advice and information in their areas of expertise to AGS for consideration in the EA which will include the recommended surface protection and reclamation requirements.

(2) When the GEAP chooses to review the draft EA, BLM-DO and FWS-RO will also be sent copies of the AGS draft EA for its review and comment.

(3) In every case, BLM-SO and FWS-AO and GEAP will be provided with a copy of the final EA.

3. Competitive lease Sales. (Primary responsibility - BLM)

In steps (a) through (h) below, the GS contact will be the AGS, and the FWS contact the appropriate FWS-AO. In step (d) below, the BLM contact will be the BLM-DO involved. For all other lease sale matters, the appropria BLM-SO involved will be the primary contact.

(a) To facilitate the sale procedure BLM-SO shall notify AGS and FWS-AO in writing at least 90 calendar days prior to sale date concerning:

(1) Areas within KGRA to be considered for competitive lease sale.

(2) Problems as they may relate to parceling; i.e., grandfathe rights, environmentally sensitive areas (described by legal subdivision) pending law suits or restraining orders, etc.

(3) Any identifiable proposed lease stipulations even though there may be subsequent additions to or modification thereof.

(4) Request GS-RCM recommendations for parceling of tracts or leasing units and for rental and royalty rates at least 60 days prior to scheduled sale date.

(b) It will be BLM-SO responsibility to establish priority of processing and scheduling with input from the GS-RCM and FWS-RO

(c) GS-RCM will recommend rental and royalty rates and parceling into tracts or leasing units for the competitive sale, submitting such information with 30 calendar days from date of request, whenever possible to BLM-SO.

(d) EAR preparation will be the responsibility of the BLM-SO as outlined in Section 2(a).

(e) Publication of Lease-Sale Notice will be the responsibility of the BLM-SO. AGS concurrence must be recieved prior to publication. The BLM-SO will send a copy of the lease sale notice and lease stipulations to the AGS and the FWS-AO for final review, allowing at least 10 working days for comment.

(f) GS-RCM will prepare a pre-sale geothermal resources economic evaluation for all tracts in the sale. Prior to the scheduled sale the GS-RCM or his designee shall be available to meet with the BLM-SO

and present the technical evaluation of the offered tracts and be prepared to discuss the geologic, engineering, and economic factors upon which the evaluation have been prepared.

(g) Immediately after the sale, the GS-RCM evaluation committee will meet to study the results of the sale. The committee will review its geologic, geophysical, economic and engineering data on all tracts and identify those tracts recommended for acceptance and for rejection supporting the recommendations with appropriate technical information. Immediately following this evaluation, the BLM-SO and GS-RCM committee will meet jointly and the GS-RCM or his designee shall present the GS technical evaluation of and recommendations on each tract for which bid have been received. The GS-RCM will submit his recommendations in writing to the BLM-SO.

(h) BLM-SO will send two copies of the executed lease, including lease terms, to the AGS for his records.

4. Non-Competitive Lease Applications (Primary responsibility - BLM)

(a) Serial Register Page.

The BLM-SO receives applications for non-competitive leases, prepares Serial Register Pages, and processes applications (at end of filing period) to determine if acceptable and if lands are available. Where an agency other than BLM administers withdrawn or acquired lands, BLM-SO will obtain a title report from that agency. The BLM-SO will send information copy of Serial Register Page to BLM-DO, AGS, and the FWS-AO.

(b) Competitive Interest Overlaps.

After reviewing each month's applications BLM-SO will send GS two copies (one to AGS and one direct to the GS-AG ro GS-DG listed below) of those applications which result in competitive interest overlap as defined by 43 CFR 3200.0-5(k)(3); a copy of the land status plat showing applications and overlaps will also be sent to the GS-AG or GS-DG listed below. GS-RCM will review competitive interest overlap as soon as practical after receipt from BLM-SO. GS-RCM will notify BLM-SO as soon as KGRA's have been defined.

For Applications within States of:	Send Overlap Information to:
Montana	GS-DG, Billings, Montana
Wyoming	GS-AG, Casper, Wyoming
Utah	GS-DG, Salt Lake City, Utah
Colorado	GS-AG, Denver, Colorado
New Mexico	GS-AG, Roswell, New Mexico
Alaska	GS-AG, Anchorage, ALaska
California, Oregon, Washington, Idaho, Nevada, Arizona	GS-AG, Menlo Park, California
Eastern States	GS-AG, Washington, D. C.

(c) Environmental Considerations.

BLM-DO will prepare an EAR requesting input and technical advice and information from the AGS, the FWS-AO and other agencies as necessary.

(d) KGRA Clear Listing - Issuance of Lease

BLM-SO will prepare lease forms and develop lease stipulations in consultation with the AGS, which will be sent to the AGS for final review and concurrence. Upon receipt of AGS concurrence, BLM-SO will forward lease form for applicant's signature. Upon receipt of lease signed by applicant, BLM-SO will forward lease forms to the AGS for final clear listing. The AGS will forward lease forms to the appropriate GS-AG or GS-DG who will then submit a KGRA clear listing report and return the lease forms to the BLM-SO. The GS-AG or GS-DG will also provide the AGS with an informational copy of the clear listing report. The BLM-SO will then issue the lease providing the AGS with two copies, including the stipulations.

5. Pre-Lease Exploration Permit (Primary responsibility - BLM)

(a) Upon receipt of a Notice of Intent to Conduct Geothermal Resources Exploration Operations, the BLM-DO will forward a copy of the Notice of Intent and any attachments to the AGS and the FWS-AO. This may include appropriate stipulation or documents relating to access routes across BLM lands.

The AGS and FWS-AO will notify the BLM-DO within five working days of any recommended stipulations considered desirable. The BLM-DO will send the AGS a copy of the approved permit.

(b) It will be the responsibility of the BLM-DO to see that the operator conducts exploration in accordance with regulations and terms of the permit. AGS and FWS-AO personnel are available, on request, to assist in supervision of operations under such permit.

(c) The BLM-DO will send the AGS a copy of the Notice of Completion

6. Post-Lease Notice of Intent to Conduct Geothermal Resources Exploration Operations (Primary responsibility - GS)

(a) Upon receipt of a Notice of Intent to Conduct Geothermal Resource Exploration Operations from an operator on an existing lease (as required by 30 CFR 270.78), the AGS will immediately forward a copy of the Notice and the required Plan of Operation to the BLM-DO and FWS-AO. The BLM-DO and FWS-AO will recommend any additional surface protection, reclamation requirements, and fish and wildlife protection measures including mitigations within their area of expertise.

(b) Upon receipt of the Notice of Intent and the required Plan of operation, an Environmental Analysis (EA) will be prepared by the AGS.

(c) It will be the responsibility of the AGS to see that exploratory operations on the lease concerned are conducted in accordance with regulations, GRO Oders, the approved Plan of Operation and Notice of Intent. The AGS will notify the BLM-DO in writing if the permittee does not comply with surface protection, fish and wildlife protection measures, reclamation requirements, and the corrective action taken or recommended. In cases of emergency, where serious surface or environmental damage occurs, or appears imminent, the BLM-DO may, if the AGS or his representative is not immediately available, issue a stop order to the lessee or his representative and then immediately notify the AGS.

7. Plan of Operation and Application for Permit to Drill (APD)

(Primary responsibility - GS)

(a) Upon receipt by the AGS of an Application for Permit to Drill, the AGS will immediately send a copy of the Plan of Operation (per 30 CFR 270.34) and APD (form 9-331C with proprietary information deleted as necessary) to the BLM-DO, the FWS-AO and the FWS-RO.

(b) For exploratory wells, and for all other drilling operations where GS, BLM, or FWS considers such necessary, the AGS will schedule with BLM-DO, FWS-AO, and the operator, a joint on-site inspection and discussion of the proposed operation and proposed access routes over BLM lands. The operator will normally be encouraged to discuss the proposed action and conduct the on-site inspection with the BLM-DO, AGS, and FWS-AO, prior to writing his drilling program and Plan of Operation.

(c) If BLM-DO, FWS-AO, or AGS consider that additional information is necessary in the Plan of Operation, the AGS shall request the operator to provide such input as deemed necessary.

(d) When such additional information is requested, the operator will submit a final Plan of Operation or supplements to the Plan of Operation to the AGS who will forward a copy of same to BLM-DO and the FWS-AO.

(e) The BLM-DO and the FWS-AO will notify the AGS in writing of any special conditions which are recommended for inclusion in the approved plan of Operation.

(f) Upon receipt of the Plan of Operation, an EA will be prepared by the AGS. The EA prepared for subsequent well operations or for the post-lease Notice of Intent to Conduct Geothermal Resource Exploration Operation may vary in level of detail depending on the nature of the operation, the sensitivity of the area, and other appropriate considerations

(g) The AGS will prepare and sign a letter of approval of the Plan of Operation containing conditions of approval mutually agreeable to both the BLM-DO and the AGS, and send the signed letter to the BLM-DO for approva

(h) BLM-DO will sign the letter to complete the joint approval of Plan of Operation and forward an approved copy to lessee and an executed copy to the AGS and FWS-AO. The BLM-DO also forwards other documents relating to access over BLM lands outside the leased area to the operator with an information copy to the AGS and FWS-AO.

(i) The AGS will then approve the Application for Permit to Drill (Form 9-331C) and furnish a copy to the BLM-DO and the FWS-AO.

(j) The AGS will be responsible for compliance inspections of all operations conducted under the Plan of Operation and Application to Drill in the Area of Operations. However, BLM-DO and FWS-AO may inspect operations to assure conditions of the approved Plan of Operation are being met and will notify AGS of any non-compliance observed. The AGS will seek and utilize BLM-DO and the FWS-AO on surface management reclamation and fish and wildlife matters, and will request inspection assistance when considered necessary within their areas of expertise. AGS is the sole contact with operators except in cases of emergency. BLM-DO may issue instructions, notices, or orders to the operator only under the following emergency circumstances and conditions: (1) emergen situation exists that clearly threaten immediate serious or irreparable damage to the environment and resources or to the health and safety of employees and/or the public; or (2) the AGS representative is not timely available to take the necessary immediate action. The BLM-DO may in such emergency situations order the immediate cessation or correction of activities responsible for the emergency sit··tion and may order repair or correction of damages, such orders to be followed by prompt telephoned

(b) For exploratory wells, and for all other drilling operations where GS, BLM, or FWS considers such necessary, the AGS will schedule with BLM-DO, FWS-AO, and the operator, a joint on-site inspection and discussion of the proposed operation and proposed access routes over BLM lands. The operator will normally be encouraged to discuss the proposed action and conduct the on-site inspection with the BLM-DO, AGS, and FWS-AO, prior to writing his drilling program and Plan of Operation.

(c) If BLM-DO, FWS-AO, or AGS consider that additional information is necessary in the Plan of Operation, the AGS shall request the operator to provide such input as deemed necessary.

(d) When such additional information is requested, the operator will submit a final Plan of Operation or supplements to the Plan of Operation to the AGS who will forward a copy of same to BLM-DO and the FWS-AO.

(e) The BLM-DO and the FWS-AO will notify the AGS in writing of any special conditions which are recommended for inclusion in the approved plan of Operation.

(f) Upon receipt of the Plan of Operation, an EA will be prepared by the AGS. The EA prepared for subsequent well operations or for the post-lease Notice of Intent to Conduct Geothermal Resource Exploration Operation may vary in level of detail depending on the nature of the operation, the sensitivity of the area, and other appropriate considerations

(g) The AGS will prepare and sign a letter of approval of the Plan of Operation containing conditions of approval mutually agreeable to both the BLM-DO and the AGS, and send the signed letter to the BLM-DO for approva

(h) BLM-DO will sign the letter to complete the joint approval of Plan of Operation and forward an approved copy to lessee and an executed copy to the AGS and FWS-AO. The BLM-DO also forwards other documents relating to access over BLM lands outside the leased area to the operator with an information copy to the AGS and FWS-AO.

(i) The AGS will then approve the Application for Permit to Drill (Form 9-331C) and furnish a copy to the BLM-DO and the FWS-AO.

(j) The AGS will be responsible for compliance inspections of all operations conducted under the Plan of Operation and Application to Drill in the Area of Operations. However, BLM-DO and FWS-AO may inspect operations to assure conditions of the approved Plan of Operation are being met and will notify AGS of any non-compliance observed. The AGS will seek and utilize BLM-DO and the FWS-AO on surface management reclamation and fish and wildlife matters, and will request inspection assistance when considered necessary within their areas of expertise. AGS is the sole contact with operators except in cases of emergency. BLM-DO may issue instructions, notices, or orders to the operator only under the following emergency circumstances and conditions: (1) emergen situation exists that clearly threaten immediate serious or irreparable damage to the environment and resources or to the health and safety of employees and/or the public; or (2) the AGS representative is not timely available to take the necessary immediate action. The BLM-DO may in such emergency situations order the immediate cessation or correction of activities responsible for the emergency sit··tion and may order repair or correction of damages, such orders to be followed by prompt telephoned

and documented notification to the AGS of the action taken. BLM-DO will be responsible for all acitivities outside the Area of Operation, within the leasehold.

(k) Any desired significant changes in a Plan of Operation must be jointly approved by both BLM-DO and AGS.

8. Plans of Operation for Surface Installations or Subsequent Well Work

A Plan of Operation as per 30 CFR 270.34 will be required for all surface construction operations and subsequent well work. Procedure for approval will be as per 7(a) through (h) above. Joint on-site inspections may not be required, unless specifically considered necessary by AGS, BLM-DO, or FWS-AO. The AGS will be responsible for compliance inspections in the Area of Operations. BLM will have the same option covered in 7(j).

9. Plans of Development, Injection, or Production

The operator will be required to submit (1) a Plan of Development prior to entering the development stage of its operation as determined by mutual agreement between the operator and the AGS, (2) a Plan of Injection where fluid injection is proposed, and (2) a Plan for Production prior to commencing production for commercial utilization of the geotherma resource. Procedure for joint BLM-DO and AGS approval will be essentially as per 7(a) through (h), described above for the Plan of Operation. The AGS will be responsible for compliance inspections in the Area of Operations.

10. Designation of Operator

The AGS will furnish BLM-DO a copy of any Designation of Operator received.

11. Filing and Termination of Bonds

(a) BLM-SO will routinely advise the AGS of the filing of any lease compliance (3206.1-1(b)) or protection bonds (3206.1-1(c)). The AGS will not permit operations on a lease until advised by BLM-SO that such bonds have been filed.

(b) The period of liability under any bond shall not be terminated by BLM until the AGS has advised the BLM-SO and FWS-AO that all terms and conditions, insofar as operations on the lease are concerned, have been fulfilled.

12. Relinquishments

BLM-SO will furnish the AGS a copy of any lease relinquishment filed. The AGS will furnish BLM-SO and the FWS-RO a report as to satisfactory restoration and abandonment of any affected portion of leased lands.

13. Annual Environmental Report

The AGS will furnish the BLM-DO a copy of the lessee's annual report of compliance with environmental protection requirements as required under 30 CFR 270.76. These reports will be available for inspection at either office for FWS-AO inspection.

14. Annual Report of Diligent Exploration

AGS will advise BLM-SO of the amount of expenditures considered qualified for diligent exploration pursuant to 43 CFR 3203.5.

15. Designation of Coordinating Offices for Purposes of the Memorandum

(a) For the U. S. Geological Survey, the office of the Assistant Division Chief of Operations, Conservation Division is designated as the coordinating office.

(b) For the Bureau of Land Management, the Division of Minerals Resources is designated as the coordinating office.

(c) For the U. S. Fish and Wildlife Service, the Office of Biological Services is designated as the coordinating office.

16. General Provisions

All assistance rendered under this Agreement will be carried out in full compliance with the objectives, policies, and responsibilities of the Department. Any unresolved matters concerning geothermal program where there is a mutual interest shall be referred for resolution to the next supervisory level involved.

The above cooperative procedures are in accord with S.O. 2948 between BLM and GS and supersedes all other implementing cooperative procedures involving geothermal leasing, administration, and supervision.

The AGS, BLM-SO and FWS-RO will meet, as necessary, to surface internal problems which occur as a result of implementing the requirements of this Agreement and to develop strategies for mitigating those problems.

This Agreement shall become effective upon execution hereof by the Directors. At least three months prior to the first and subsequent anniversary dates hereof, the AGS, BLM-SO, and FWS-RO shall apprise their respective coordinating offices of any suggested modifications in this Agreement which would improve its workability, reduce duplication

of effort, and enhance the ability of the Department to perform its assigned functions relating to the leasing of Federal lands for geothermal resources and approval of operations in a more timely manner.

Acting Director, Fish and Wildlife Service — 6/7/76 Date

Acting Director, Bureau of Land Management — 5/28/76 Date

Acting Director, Geological Survey — 6.1.76 Date

UNITED STATES
DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY
Conservation Division
Area Geologist's Office
345 Middlefield Road
Menlo Park, California 94025

September 15, 1976

Memorandum

To: Area Geologist, Pacific Area

From: Assistant Area Geologist, Menlo Park

Subject: Procedure for processing geothermal plan of operations and APD (applications to drill)

I've discussed this subject with Barry Boudreau and the following is his description of what takes place.

An operators plan of operations and APD comes into the Operations Section. Barry sends a complete copy to us for our information, review, and file. They are interested in our comments on the plan's adequacy and our geologic hazards report. We may want to add a multiple-mineral use conflict report for each lease that wasn't analysed when it was clearlisted. Barry sends a complete copy to the Engineering section and a copy of the cover page to the Environmental section. Engineering waits for our report and the Environmental section's EA before preparing their report. The Environmental Section prepares an interested parties letter and schedules an inspection of the proposed drill site. We may attend the inspection if we wish and are normally asked to review and provide input to the EA.

Barry suggested that our geologists contact Bruce Hellier for the name of the individual in his section who is assigned the same plan of operations or APD that he is working on. Such contact could provide for coordination of effort and a source of education on the engineering jargon used in the plan and APD.

Vern

E. Vernon Stephens

EVS/jv

File: Geothermal 1

Area Geologist's Office Role
in processing lease plans,
APD's, and EA's

1st Step

Company initiates process by submitting lease plan to CD, usually with one or more applications for permit to drill (APD's).

2nd Step

Geothermal Supervisor then required to prepare an environmental analysis (EA) on the lessee's plan.

3rd Step

Copy of lease plan and APD's are transmitted to Area Geologist's office from Geothermal. Our role is basically three-fold:

1. Lease plan - Review for all facets of proper development consonant w/geology, geologic hazards, and economics. Particularly interested in whether the amount and degree of surface disturbance is necessary for the conduct of operating on the basis of what we know about geology and potential of the area.

2. APD's - Review for geologic hazards, both surface and subsurface.

3. EA's - Provide any additional information or further amplification of the statements in the lease plan submitted by the operator. Make any suggestions to assist the Geothermal Supervisor's office in preparing EA.

General Comments:

Lease plans, APD's and EA's are evidence that the lessee is about to commence operations involving drilling on Federal lands. We must play an active role in insuring that all potential geologic hazards are identified. Our view is that if we identify the potential hazard, then we can engineer around it.

We function in review role and will not normally generate generalized geologic write-ups from scratch. We assist in EA preparation by providing additional comments.

Henry L. Cullins

U. S. Geological Survey
Conservation Division

To: Area Geothermal Supervisor

From: Office of the Pacific Area Geologist

Subject: Geologic Review of Plan of Operations for Geothermal Leases

State and Area: _____
Operator: _____ Lease No: _____
Application and Well No: _____
Location: _____

Plan of operation is considered

( ) Adequate

( ) Adequate but with reservations (comments)

( ) Inadequate (comments)

Date: _____ Geologist: _____

U. S. Geological Survey
Conservation Division

To: Area Geothermal Supervisor

From: Office of the Pacific Area Geologist

Subject: Geologic Review of APD

Area: _____
Operator: _____ Lease No: _____
Application and well no: _____
Location: _____

Potential steam or thermal water producing horizon (depth, thickness, characteristics):

Rock type and structure at the well site:

Potential seismic hazards:

Nearby faults and seismic activity:

Possible subsurface faults which may be encountered in drilling (approximate depth):

Other (liquefaction, differential settling, etc.):

Slope stability hazards:

Slumps, landslides, etc:

Surface creep:

Soil erosion:

Subsidence hazards:

Regional (fluid withdrawal):

Site (sinter aprons, settling):

Grand water (depth, thickness, quality):

Other geologic conditions requiring special consideration:

References:

Date:_____ Geologist:_____

S. 391

Ninety-fourth Congress of the United States of America

AT THE SECOND SESSION

Begun and held at the City of Washington on Monday, the nineteenth day of January, one thousand nine hundred and seventy-six

RECEI
Conservation Di
U.S. GEOLOGICAL
Office of the
Menlo

An Act

To amend the Mineral Leasing Act of 1920, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That (a) this Act may be cited as the "Federal Coal Leasing Amendments Act of 1975".

(b) Except as otherwise expressly provided, whenever in this Act an amendment or repeal is expressed in terms of an amendment to, or repeal of, a section or other provision of the Mineral Lands Leasing Act, the reference shall be considered to be made to a section or other provision of the Act of February 25, 1920, entitled "An Act to promote the mining of coal, phosphate, oil, oil shale, gas, and sodium on the public domain" (41 Stat. 437).

SEC. 2. The first sentence of section 2(a) of the Mineral Lands Leasing Act (30 U.S.C. 201(a)) is amended to read as follows:

"(1) The Secretary of the Interior is authorized to divide any lands subject to this Act which have been classified for coal leasing into leasing tracts of such size as he finds appropriate and in the public interest and which will permit the mining of all coal which can be economically extracted in such tract and thereafter he shall, in his discretion, upon the request of any qualified applicant or on his own motion, from time to time, offer such lands for leasing and shall award leases thereon by competitive bidding. No less than 50 per centum of the total acreage offered for lease by the Secretary in any one year shall be leased under a system of deferred bonus payment. Upon default or cancellation of any coal lease for which bonus payments are due, any unpaid remainder of the bid shall be immediately payable to the United States. A reasonable number of leasing tracts shall be reserved and offered for lease in accordance with this section to public bodies, including Federal agencies, rural electric cooperatives, or non-profit corporations controlled by any of such entities: *Provided*, That the coal so offered for lease shall be for use by such entity or entities in implementing a definite plan to produce energy for their own use or for sale to their members or customers (except for short-term sales to others). No bid shall be accepted which is less than the fair market value, as determined by the Secretary, of the coal subject to the lease. Prior to his determination of the fair market value of the coal subject to the lease, the Secretary shall give opportunity for and consideration to public comments on the fair market value. Nothing in this section shall be construed to require the Secretary to make public his judgment as to the fair market value of the coal to be leased, or the comments he receives thereon prior to the issuance of the lease.".

Section 4 no longer authorizes the granting of prospecting permits for coal. Therefore all coal lands are subject to competitive leasing only.

SEC. 3. The last sentence of section 2(a) of the Mineral Lands Leasing Act (30 U.S.C. 201(a)) is amended to read as follows:

"(2)(A) The Secretary shall not issue a lease or leases under the terms of this Act to any person, association, corporation, or any subsidiary, affiliate, or persons controlled by or under common control with such person, association, or corporation, where any such entity holds a lease or leases issued by the United States to coal deposits and has held such lease or leases for a period of ten years when such entity is not, except as provided for in section 7(b) of this Act, producing coal from the lease deposits in commercial quantities. In computing the ten-year period referred to in the preceding sentence, periods of time prior to the date of enactment of the Federal Coal Leasing Amendments Act of 1975 shall not be counted.

"(B) Any lease proposal which permits surface coal mining within the boundaries of a National Forest which the Secretary proposes to issue under this Act shall be submitted to the Governor of each State within which the coal deposits subject to such lease are located. No such lease may be issued under this Act before the expiration of the sixty-day period beginning on the date of such submission. If any Governor to whom a proposed lease was submitted under this subparagraph objects to the issuance of such lease, such lease shall not be issued before the expiration of the six-month period beginning on the date the Secretary is notified by the Governor of such objection. During such six-month period, the Governor may submit to the Secretary a statement of reasons why such lease should not be issued and the Secretary shall, on the basis of such statement, reconsider the issuance of such lease.

"(3)(A)(i) No lease sale shall be held unless the lands containing the coal deposits have been included in a comprehensive land-use plan and such sale is compatible with such plan. The Secretary of the Interior shall prepare such land-use plans on lands under his responsibility where such plans have not been previously prepared. The Secretary of the Interior shall inform the Secretary of Agriculture of substantial development interest in coal leasing on lands within the National Forest System. Upon receipt of such notification from the Secretary of the Interior, the Secretary of Agriculture shall prepare a comprehensive land-use plan for such areas where such plans have not been previously prepared. The plan of the Secretary of Agriculture shall take into consideration the proposed coal development in these lands: *Provided*, That where the Secretary of the Interior finds that because of non-Federal interest in the surface or because the coal resources are insufficient to justify the preparation costs of a Federal comprehensive land-use plan, the lease sale can be held if the lands containing the coal deposits have been included in either a comprehensive land-use plan prepared by the State within which the lands are located or a land use analysis prepared by the Secretary of the Interior.

"(ii) In preparing such land-use plans, the Secretary of the Interior or, in the case of lands within the National Forest System, the Secretary of Agriculture, or in the case of a finding by the Secretary of the Interior that because of non-Federal interests in the surface or insufficient Federal coal, no Federal comprehensive land-use plans can

be appropriately prepared, the responsible State entity shall consult with appropriate State agencies and local governments and the general public and shall provide an opportunity for public hearing on proposed plans prior to their adoption, if requested by any person having an interest which is, or may be, adversely affected by the adoption of such plans.

"(iii) Leases covering lands the surface of which is under the jurisdiction of any Federal agency other than the Department of the Interior may be issued only upon consent of the other Federal agency and upon such conditions as it may prescribe with respect to the use and protection of the nonmineral interests in those lands.

"(B) Each land-use plan prepared by the Secretary (or in the case of lands within the National Forest System, the Secretary of Agriculture pursuant to subparagraph (A)(i)) shall include an assessment of the amount of coal deposits in such land, identifying the amount of such coal which is recoverable by deep mining operations and the amount of such coal which is recoverable by surface mining operations.

"(C) Prior to issuance of any coal lease, the Secretary shall consider effects which mining of the proposed lease might have on an impacted community or area, including, but not limited to, impacts on the environment, on agricultural and other economic activities, and on public services. Prior to issuance of a lease, the Secretary shall evaluate and compare the effects of recovering coal by deep mining, by surface mining, and by any other method to determine which method or methods or sequence of methods achieves the maximum economic recovery of the coal within the proposed leasing tract. This evaluation and comparison by the Secretary shall be in writing but shall not prohibit the issuance of a lease; however, no mining operating plan shall be approved which is not found to achieve the maximun economic recovery of the coal within the tract. Public hearings in the area shall be held by the Secretary prior to the lease sale.

"(D) No lease sale shall be held until after the notice of the proposed offering for lease has been given once a week for three consecutive weeks in a newspaper of general circulation in the county in which the lands are situated in accordance with regulations prescribed by the Secretary.

"(E) Each coal lease shall contain provisions requiring compliance with the Federal Water Pollution Control Act (33 U.S.C. 1151–1175) and the Clean Air Act (42 U.S.C. 1857 and following).".

SEC. 4. Subject to valid existing rights, section 2(b) of the Mineral Lands Leasing Act (30 U.S.C. 201(b)) is amended to read as follows:.

"(b)(1) The Secretary may, under such regulations as he may prescribe, issue to any person an exploration license. No person may conduct coal exploration for commercial purposes for any coal on lands subject to this Act without such an exploration license. Each exploration license shall be for a term of not more than two years and shall be subject to a reasonable fee. An exploration license shall confer no right to a lease under this Act. The issuance of exploration licenses shall not preclude the Secretary from issuing coal leases at such times and locations and to such persons as he deems appropriate. No exploration license will be issued for any land on which a coal lease has been

issued. A separate exploration license will be required for exploration in each State. An application for an exploration license shall identify general areas and probable methods of exploration. Each exploration license shall contain such reasonable conditions as the Secretary may require, including conditions to insure the protection of the environment, and shall be subject to all applicable Federal, State, and local laws and regulations. Upon violation of any such conditions or laws the Secretary may revoke the exploration license.

"(2) A licensee may not cause substantial disturbance to the natural land surface. He may not remove any coal for sale but may remove a reasonable amount of coal from the lands subject to this Act included under his license for analysis and study. A licensee must comply with all applicable rules and regulations of the Federal agency having jurisdiction over the surface of the lands subject to this Act. Exploration licenses covering lands the surface of which is under the jurisdiction of any Federal agency other than the Department of the Interior may be issued only upon such conditions as it may prescribe with respect to the use and protection of the nonmineral interests in those lands.

"(3) The licensee shall furnish to the Secretary copies of all data (including, but not limited to, geological, geophysical, and core drilling analyses) obtained during such exploration. The Secretary shall maintain the confidentiality of all data so obtained until after the areas involved have been leased or until such time as he determines that making the data available to the public would not damage the competitive position of the licensee, whichever comes first.

"(4) Any person who willfully conducts coal exploration for commercial purposes on lands subject to this Act without an exploration license issued hereunder shall be subject to a fine of not more than $1,000 for each day of violation. All data collected by said person on any Federal lands as a result of such violation shall be made immediately available to the Secretary, who shall make the data available to the public as soon as it is practicable. No penalty under this subsection shall be assessed unless such person is given notice and opportunity for a hearing with respect to such violation.".

SEC. 5. (a) Subject to valid existing rights, subsections 2(c) and 2(d) of the Act of August 31, 1964 (78 Stat. 710; 30 U.S.C. 201–1) are hereby repealed.

(b) Section 2 of the Mineral Lands Leasing Act is amended by the addition of the following new subsection at the end thereof:

"(d)(1) The Secretary, upon determining that maximum economic recovery of the coal deposit or deposits is served thereby, may approve the consolidation of coal leases into a logical mining unit. Such consolidation may only take place after a public hearing, if requested by any person whose interest is or may be adversely affected. A logical mining unit is an area of land in which the coal resources can be developed in an efficient, economical, and orderly manner as a unit with due regard to conservation of coal reserves and other resources. A logical mining unit may consist of one or more Federal leaseholds, and may include intervening or adjacent lands in which the United States does not own the coal resources, but all the lands in a logical mining unit must be under the effective control of a single operator,

be able to be developed and operated as a single operation and be contiguous.

"(2) After the Secretary has approved the establishment of a logical mining unit, any mining plan approved for that unit must require such diligent development, operation, and production that the reserves of the entire unit will be mined within a period established by the Secretary which shall not be more than forty years.

"(3) In approving a logical mining unit, the Secretary may provide, among other things, that (i) diligent development, continuous operation, and production on any Federal lease or non-Federal land in the logical mining unit shall be construed as occurring on all Federal leases in that logical mining unit, and (ii) the rentals and royalties for all Federal leases in a logical mining unit may be combined, and advanced royalties paid for any lease within a logical mining unit may be credited against such combined royalties.

"(4) The Secretary may amend the provisions of any lease included in a logical mining unit so that mining under that lease will be consistent with the requirements imposed on that logical mining unit.

"(5) Leases issued before the date of enactment of this Act may be included with the consent of all lessees in such logical mining unit, and, if so included, shall be subject to the provisions of this section.

"(6) By regulation the Secretary may require a lessee under this Act to form a logical mining unit, and may provide for determination of participating acreage within a unit.

"(7) No logical mining unit shall be approved by the Secretary if the total acreage (both Federal and non-Federal) of the unit would exceed twenty-five thousand acres.

"(8) Nothing in this section shall be construed to waive the acreage limitations for coal leases contained in section 27(a) of the Mineral Lands Leasing Act (30 U.S.C. 184(a)).".

SEC. 6. Section 7 of the Mineral Lands Leasing Act (30 U.S.C. 207) is amended to read as follows:

"SEC. 7. (a) A coal lease shall be for a term of twenty years and for so long thereafter as coal is produced annually in commercial quantities from that lease. Any lease which is not producing in commercial quantities at the end of ten years shall be terminated. The Secretary shall by regulation prescribe annual rentals on leases. A lease shall require payment of a royalty in such amount as the Secretary shall determine of not less than 12½ per centum of the value of coal as defined by regulation, except the Secretary may determine a lesser amount in the case of coal recovered by underground mining operations. The lease shall include such other terms and conditions as the Secretary shall determine. Such rentals and royalties and other terms and conditions of the lease will be subject to readjustment at the end of its primary term of twenty years and at the end of each ten-year period thereafter if the lease is extended.

"(b) Each lease shall be subject to the conditions of diligent development and continued operation of the mine or mines, except where operations under the lease are interrupted by strikes, the elements, or casualties not attributable to the lessee. The Secretary of the Interior, upon determining that the public interest will be served thereby, may suspend the condition of continued operation upon the payment

of advance royalties. Such advance royalties shall be no less than the production royalty which would otherwise be paid and shall be computed on a fixed reserve to production ratio (determined by the Secretary). The aggregate number of years during the period of any lease for which advance royalties may be accepted in lieu of the condition of continued operation shall not exceed ten. The amount of any production royalty paid for any year shall be reduced (but not below 0) by the amount of any advance royalties paid under such lease to the extent that such advance royalties have not been used to reduce production royalties for a prior year. No advance royalty paid during the initial twenty-year term of a lease shall be used to reduce a production royalty after the twentieth year of a lease. The Secretary may, upon six months' notification to the lessee cease to accept advance royalties in lieu of the requirement of continued operation. Nothing in this subsection shall be construed to affect the requirement contained in the second sentence of subsection (a) relating to commencement of production at the end of ten years.

"(c) Prior to taking any action on a leasehold which might cause a significant disturbance of the environment, and not later than three years after a lease is issued, the lessee shall submit for the Secretary's approval an operation and reclamation plan. The Secretary shall approve or disapprove the plan or require that it be modified. Where the land involved is under the surface jurisdiction of another Federal agency, that other agency must consent to the terms of such approval.".

SEC. 7. The Mineral Lands Leasing Act is amended by inserting after section 8 the following new section 8A:

"SEC. 8A. (a) The Secretary is authorized and directed to conduct a comprehensive exploratory program designed to obtain sufficient data and information to evaluate the extent, location, and potential for developing the known recoverable coal resources within the coal lands subject to this Act. This program shall be designed to obtain the resource information necessary for determining whether commercial quantities of coal are present and the geographical extent of the coal fields and for estimating the amount of such coal which is recoverable by deep mining operations and the amount of such coal which is recoverable by surface mining operations in order to provide a basis for—

"(1) developing a comprehensive land use plan pursuant to section 2;

"(2) improving the information regarding the value of public resources and revenues which should be expected from leasing;

"(3) increasing competition among producers of coal, or products derived from the conversion of coal, by providing data and information to all potential bidders equally and equitably;

"(4) providing the public with information on the nature of the coal deposits and the associated stratum and the value of the public resources being offered for sale; and

"(5) providing the basis for the assessment of the amount of coal deposits in those lands subject to this Act under subparagraph (B) of section 2(a)(3).

"(b) The Secretary, through the United States Geological Survey, is authorized to conduct seismic, geophysical, geochemical, or strati-

graphic drilling, or to contract for or purchase the results of such exploratory activities from commercial or other sources which may be needed to implement the provisions of this section.

"(c) Nothing in this section shall limit any person from conducting exploratory geophysical surveys including seismic, geophysical, chemical surveys to the extent permitted by section 2(b). The information obtained from the exploratory drilling carried out by a person not under contract with the United States Government for such drilling prior to award of a lease shall be provided the confidentiality pursuant to subsection (d).

"(d) The Secretary shall make available to the public by appropriate means all data, information, maps, interpretations, and surveys which are obtained directly by the Department of the Interior or under a service contract pursuant to subsection (b). The Secretary shall maintain a confidentiality of all proprietary data or information purchased from commercial sources while not under contract with the United States Government until after the areas involved have been leased.

"(e) All Federal departments or agencies are authorized and directed to provide the Secretary with any information or data that may be deemed necessary to assist the Secretary in implementing the exploratory program pursuant to this section. Proprietary information or data provided to the Secretary under the provisions of this subsection shall remain confidential for such period of time as agreed to by the head of the department or agency from whom the information is requested. In addition, the Secretary is authorized and directed to utilize the existing capabilities and resources of other Federal departments and agencies by appropriate agreement.

"(f) The Secretary is directed to prepare, publish, and keep current a series of detailed geological, and geophysical maps of, and reports concerning, all coal lands to be offered for leasing under this Act, based on data and information compiled pursuant to this section. Such maps and reports shall be prepared and revised at reasonable intervals beginning eighteen months after the date of enactment of this Act. Such maps and reports shall be made available on a continuing basis to any person on request.

"(g) Within six months after the date of enactment of this Act, the Secretary shall develop and transmit to Congress an implementation plan for the coal lands exploration program authorized by this section, including procedures for making the data and information available to the public pursuant to subsection (d), and maps and reports pursuant to subsection (f). The implementation plan shall include a projected schedule of exploratory activities and identification of the regions and areas which will be explored under the coal lands exploration program during the first five years following the enactment of this section. In addition, the implementation plan shall include estimates of the appropriations and staffing required to implement the coal lands exploration program.

"(h) The stratigraphic drilling authorized in subsection (b) shall be carried out in such a manner as to obtain information pertaining to all recoverable reserves. For the purpose of complying with subsection (a), the Secretary shall require all those authorized to conduct

stratigraphic drilling pursuant to subsection (b) to supply a statement of the results of test boring of core sampling including logs of the drill holes; the thickness of the coal seams found; an analysis of the chemical properties of such coal; and an analysis of the strata layers lying above all the seams of coal. All drilling activities shall be conducted using the best current technology and practices.".

SEC. 8. The Mineral Lands Leasing Act is further amended by adding after section 8A the following new section 8B:

"SEC. 8B. Within six months after the end of each fiscal year, the Secretary shall submit to the Congress a report on the leasing and production of coal lands subject to this Act during such fiscal year; a summary of management, supervision, and enforcement activities; and recommendations to the Congress for improvements in management, environmental safeguards, and amount of production in leasing and mining operations on coal lands subject to this Act. Each submission shall also contain a report by the Attorney General of the United States on competition in the coal and energy industries, including an analysis of whether the antitrust provisions of this Act and the antitrust laws are effective in preserving or promoting competition in the coal or energy industry.".

SEC. 9. (a) Section 35 of the Mineral Lands Leasing Act, as amended (30 U.S.C. 191) is further amended by deleting "52½ per centum thereof shall be paid into. reserved" and inserting in lieu thereof: "40 per centum thereof shall be paid into, reserved", and is further amended by striking the period at the end of the proviso and inserting in lieu thereof the following language: ": *Provided further*, That an additional 12½ per centum of all moneys received from sales, bonuses, royalties, and rentals of public lands under the provisions of this Act and the Geothermal Steam Act of 1970 shall be paid by the Secretary of the Treasury as soon as practicable after December 31 and June 30 of each year to the State within the boundaries of which the leased lands or deposits are or were located; said additional 12½ per centum of all moneys paid to any State on or after January 1, 1976, shall be used by such State and its subdivisions as the legislature of the State may direct giving priority to those subdivisions of the State socially or economically impacted by development of minerals leased under this Act for (1) planning, (2) construction and maintenance of public facilities, and (3) provision of public services: *Provided further*, That such funds now held or to be received, by the States of Colorado and Utah separately from the Department of the Interior oil shale test leases known as 'C–A'; 'C–B'; 'U–A' and 'U–B' shall be used by such States and subdivisions as the legislature of each State may direct giving priority to those subdivisions socially or economically impacted by the development of minerals leased under this Act for (1) planning, (2) construction and maintenance of public facilities, and (3) provision of public services.".

(b) In the first sentence of section 35 of the Mineral Lands Leasing Act, before the words "shall be paid into the Treasury of the United States" insert "and the Geothermal Steam Act of 1970, notwithstanding the provisions of section 20 thereof,"; before the words "from lands within the naval petroleum reserves" insert "and the Geothermal Steam Act of 1970"; and, in the second sentence, before the words

"not otherwise disposed of" insert "and the Geothermal Steam Act of 1970".

SEC. 10. The Director of the Office of Technology Assessment is authorized and directed to conduct a complete study of coal leases entered into by the United States under section 2 of the Act of February 25, 1920 (commonly known as the Mineral Lands Leasing Act). Such study shall include an analysis of all mining activities, present and potential value of said coal leases, receipts of the Federal Government from said leases, and recommendations as to the feasibility of the use of deep mining technology in said leased area. The Director shall submit the results of his study to the Congress within one year after the date of enactment of this Act.

SEC. 11. (a) Section 27(a)(1) of the Mineral Lands Leasing Act (30 U.S.C. 184(a)(1)), is amended to read as follows:

"(1) No person, association, or corporation, or any subsidiary, affiliate, or persons controlled by or under common control with such person, association, or corporation shall take, hold, own or control at one time, whether acquired directly from the Secretary under this Act or otherwise, coal leases or permits on an aggregate of more than forty-six thousand and eighty acres in any one State and in no case greater than an aggregate of one hundred thousand acres in the United States: *Provided*, That any person, association, or corporation currently holding, owning, or controlling more than an aggregate of one hundred thousand acres in the United States on the date of enactment of this section shall not be required on account of this section to relinquish said leases or permits: *Provided, further*, That in no case shall such person, association, or corporation be permitted to take, hold, own, or control any further Federal coal leases or permits until such time as their holdings. ownership, or control of Federal leases or permits has been reduced below an aggregate of one hundred thousand acres within the United States.".

(b) Subject to valid existing rights, section 27(a)(2) of the Mineral Lands Leasing Act (30 U.S.C. 184(a)(2)) is hereby repealed.

SEC. 12. (a) Section 3 of the Mineral Leasing Act for Acquired Lands (30 U.S.C. 352) is amended by striking out "(b) set apart for military or naval purposes, or (c)" and insert in lieu thereof "or (b)".

(b) Such section 3 is further amended by inserting the following after the first sentence thereof: "Coal or lignite under acquired lands set apart for military or naval purposes may be leased by the Secretary, with the concurrence of the Secretary of Defense, to a governmental entity (including any corporation primarily acting as an agency or instrumentality of a State) which produces electrical energy for sale to the public if such governmental entity is located in the State in which such lands are located.".

SEC. 13. (a) Subject to valid existing rights, section 4 of the Mineral Lands Leasing Act (30 U.S.C. 204) is hereby repealed.

(b) Subject to valid existing rights, section 3 of the Mineral Lands Leasing Act (30 U.S.C. 203) is amended to read as follows:

"SEC. 3. Any person, association, or corporation holding a lease of coal lands or coal deposits under the provisions of this Act may with the approval of the Secretary of the Interior, upon a finding by him that it would be in the interest of the United States, secure modifica-

tions of the original coal lease by including additional coal lands or coal deposits contiguous to those embraced in such lease, but in no event shall the total area added by such modifications to an existing coal lease exceed one hundred sixty acres, or add acreage larger than that in the original lease. The Secretary shall prescribe terms and conditions which shall be consistent with this Act and applicable to all of the acreage in such modified lease.".

SEC. 14. Section 39 of the Mineral Lands Leasing Act (30 U.S.C. 209) is amended by adding the following sentence at the end thereof: "Nothing in this section shall be construed as granting to the Secretary the authority to waive, suspend, or reduce advance royalties.".

SEC. 15. Section 27 of the Mineral Lands Leasing Act of 1920 (30 U.S.C. 184) is amended by adding at the end thereof the following new subsection:

"(l) (1) At each stage in the formulation and promulgation of rules and regulations concerning coal leasing pursuant to this Act, and at each stage in the issuance, renewal, and readjustment of coal leases under this Act, the Secretary of the Interior shall consult with and give due consideration to the views and advice of the Attorney General of the United States.

"(2) No coal lease may be issued, renewed, or readjusted under this Act until at least thirty days after the Secretary of the Interior notifies the Attorney General of the proposed issuance, renewal, or readjustment. Such notification shall contain such information as the Attorney General may require in order to advise the Secretary of the Interior as to whether such lease would create or maintain a situation inconsistent with the antitrust laws. If the Attorney General advises the Secretary of the Interior that a lease would create or maintain such a situation, the Secretary of the Interior may not issue such lease, nor may he renew or readjust such lease for a period not to exceed one year, as the case may be, unless he thereafter conducts a public hearing on the record in accordance with the Administrative Procedures Act and finds therein that such issuance, renewal, or readjustment is necessary to effectuate the purposes of this Act, that it is consistent with the public interest, and that there are no reasonable alternatives consistent with this Act, the antitrust laws, and the public interest.

"(3) Nothing in this Act shall be deemed to convey to any person, association, corporation, or other business organization immunity from civil or criminal liability, or to create defenses to actions, under any antitrust law.

"(4) As used in this subsection, the term 'antitrust law' means—

"(A) the Act entitled 'An Act to protect trade and commerce against unlawful restraints and monopolies', approved July 2, 1890 (15 U.S.C. 1 et seq.), as amended;

"(B) the Act entitled 'An Act to supplement existing laws against unlawful restraints and monopolies, and for other purposes', approved October 15, 1914 (15 U.S.C. 12 et seq.), as amended;

"(C) the Federal Trade Commission Act (15 U.S.C. 41 et seq.), as amended;

"(D) sections 73 and 74 of the Act entitled 'An Act to reduce taxation, to provide revenue for the Government, and for other purposes', approved August 27, 1894 (15 U.S.C. 8 and 9), as amended; or

"(E) the Act of June 19, 1936, chapter 592 (15 U.S.C. 13, 13a, 13b, and 21a).".

SEC. 16. Nothing in this Act, or the Mineral Lands Leasing Act and the Mineral Leasing Act for Acquired Lands which are amended by this Act, shall be construed as authorizing coal mining on any area of the National Park System, the National Wildlife Refuge System, the National Wilderness Preservation System, the National System of Trails, and the Wild and Scenic Rivers System, including study rivers designated under section 5(a) of the Wild and Scenic Rivers Act.

CARL ALBERT,
Speaker of the House of Representatives.

LEE METCALF,
Acting President of the Senate pro tempore.

I certify that this Act originated in the Senate.

FRANCIS R. VALEO,
Secretary.

d Species Act of 1973 (P.L.

piscal Fish and Wildlife
tional Museum of Natural His-
stitution Avenue, NW., Wash-
20, Dr. Clyde Jones, Director;
n, Acting Director.

OMB NO. 42-R1130

[ ] LICENSE [X] PERMIT

ACTIVITY FOR WHICH REQUESTED LICENSE

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BUSINESS, CORPORATION, PUBLIC AGENCY,
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OR BUSINESS, AGENCY, OR INSTITUTION

ish and Wildlife
a research unit of the
Wildlife Service

NUMBER OF PRESIDENT, PRINCIPAL

rector Ph: 381-5161

ORGANIZATION, INDICATE STATE IN WHICH

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effect through 12/31/77

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11. DURATION REQUESTED

December 1977

SECTION 13.41 OF 50 CFR 13 MUST BE
BEFORE SUCH ATTACHMENTS ARE

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AND I FURTHER CERTIFY THAT THE IN FOR-
THE BEST OF MY KNOWLEDGE AND BELIEF,
18 U.S.C. 1001.

DATE
16 Aug 1976

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S. Fish and Wildlife Service.
is from September 1976
77.

(e) The study is designed to ascertain the effects of phosphate mining leases on the endangered species of the Osceola National Forest, Florida. This involves assessing the composition and abundance of vertebrate populations in this area. Bats will be sampled with mist nets; it is possible that some individuals of the above two species may be taken. Such individuals would be released unharmed following the recording of data on species, sex, and age. Dead or salvaged bats would be transported to the National Museum where they would be available for subsequent study. This study will hopefully assess the possible effects of mining on endangered species in this area and provide sound management information in the event of such mining. These aims are in keeping with the mission of the U.S. Fish and Wildlife Service in protecting and conserving wildlife.

Documents and other information submitted in connection with this application are available for public inspection during normal business hours at the Service's office in Suite 600, 1612 K Street, NW., Washington, D.C.

Interested persons may comment on this application by submitting written data, views, or arguments, preferably in triplicate, to the Director (FWS/LE), U.S. Fish and Wildlife Service, Post Office Box 19183, Washington, D.C. 20036. This application has been assigned File Number PRT 2-346-07; please refer to this number when submitting comments. All relevant comments received on or before October 28, 1976.

Dated September 23, 1976.

C. R. BAVIN,
Chief, Division of Law Enforcement,
U.S. Fish and Wildlife Service.

[FR Doc.76-28368 Filed 9-27-76;8:45 am]

Geological Survey

KNOWN COAL LEASING AREAS BECOME KNOWN RECOVERABLE COAL RESOURCE AREAS

Competitive Leasing

Prior to enactment of the Federal Coal Leasing Amendments Act of 1975 on August 4, 1976, 21 known coal leasing areas involving about 9,674,396 acres in the States of Colorado, Montana, North Dakota, Utah, and Wyoming had been classified for competitive leasing and published in the FEDERAL REGISTER. Pursuant to authority contained in the Act of March 3, 1879 (43 U.S.C. 31), as supplemented by Reorganization Plan No. 3 of 1950 (43 U.S.C. 1451, note), 303 Departmental Manual 1, and Secretary's Order No. 2948, Federal lands within these 5 States were classified as subject to the competitive coal leasing provisions of the Mineral Leasing Act of February 25, 1920, as amended (30 U.S.C. 201).

The Federal Coal Leasing Amendments Act of 1975 eliminated the prospecting and preference right lease provisions of the Mineral Leasing Act of 1920 with respect to coal. Section 2(a)(1) of the amended Act requires that Federal lands be classified for coal leasing and that leases be awarded only by competitive bidding. Section 8A of the amended Act requires obtaining sufficient data to evaluate the extent, location, and potential for developing commercial quantities of the known recoverable coal resources within the Federal lands subject to leasing under this Act. Inasmuch as lands previously classified as Known Coal Leasing Areas (KCLA's) required a determination of existence and workability (physical recoverability) of coal, such lands are now judged to be the equivalent of the known recoverable coal resource lands which are to be evaluated in accordance with Section 8A(a) of the Mineral Leasing Act of February 25, 1920, as amended by the Federal Coal Leasing Amendments Act of 1975.

Therefore, the following areas previously classified as KCLA's are hereby classified for coal leasing as Known Recoverable Coal Resource Areas (KRCRA's) pursuant to the authority of the Act of March 3, 1879 (43 U.S.C. 31), as supplemented by Reorganization Plan No. 3 of 1950 (43 U.S.C. 1451, note), 303 Departmental Manual 1, and Section 3A of the Mineral Leasing Act of February 25, 1920, as added by Section 7 of the Federal Coal Leasing Amendments Act of 1975 (P.L. 94-377, August 4, 1976).

(6) *Colorado*

Paonia—Somerset; 215,867 acres, FEDERAL REGISTER, Jan. 29, 1974, p. 3693. Danforth Hills; 130,393 acres, FEDERAL REGISTER, Feb. 13, 1974, p. 5522. Yampa; 421,364 acres, FEDERAL REGISTER, Feb. 13, 1974, p. 5522. Nucla; 5,143 acres, FEDERAL REGISTER, June 29, 1976, p. 26725. Durango; 238,335 acres, FEDERAL REGISTER, July 2, 1976, p. 27405. Cimarron Ridge; 23,825 acres, FEDERAL REGISTER, July 23, 1976, p. 30356. East Cortez; 9,672 acres, FEDERAL REGISTER, July 2, 1976, p. 27405.

(26) *Montana*

Powder River Basin; 2,256,576 acres, FEDERAL REGISTER, Jan. 17, 1974, p. 2117. Wibaux—Beach; 124,048 acres, FEDERAL REGISTER, Feb. 7, 1974, p. 4790. Burns Creek—Thirteen Mile Creek; 197,355 acres, FEDERAL REGISTER, June 24, 1974, p. 22442.

(34) *North Dakota*

Williston—Avoca; 65,304 acres, FEDERAL REGISTER, March 28, 1975, p. 14105.

(44) *Utah*

Henry Mountains; 40,013 acres, FEDERAL REGISTER, Feb. 7, 1974, p. 4790. Kaiparowits Plateau; 630,895 acres, FEDERAL REGISTER, July 9, 1974, p. 25243. Wasatch Plateau; 206,810 acres, FEDERAL REGISTER, Aug. 20, 1974, p. 31542-3. Book Cliffs; 129,368 acres, FEDERAL REGISTER, Aug. 21, 1974, p. 30179.

(50) *Wyoming*

Powder River Basin; 3,951,480 acres, FEDERAL REGISTER, Oct. 1, 1973, p. 27230. Hanna and Carbon; 222,711 acres, FEDERAL REGISTER, Jan. 29, 1974, p. 3693. Kemmerer; 260,624 acres, FEDERAL REGISTER, June 3, 1974, p. 19511. Rock Springs; 416,634 acres, FEDERAL REGISTER, Nov. 3, 1974, p. 39587. Grass Creek; 1,360 acres, FEDERAL REGISTER, Jan. 28, 1975, p. 4168. Rawlings; 122,910 acres, FEDERAL REGISTER, June 29, 1976, p. 26725-26.

W. R. RADTKE,
Acting Director.

Dated: September 17, 1976.

[FR Doc.76-28322 Filed 9-27-76;8:45 am]

Coal Resource Classification System of the U.S. Bureau of Mines and U.S. Geological Survey

MINERAL RESOURCE CLASSIFICATION SYSTEMS OF THE U.S. BUREAU OF MINES AND U.S. GEOLOGICAL SURVEY

GEOLOGICAL SURVEY BULLETIN 1450-B

A report published jointly by the U.S. Bureau of Mines and U.S. Geological Survey

Definitions of coal resource classification terms used by the U.S. Bureau of Mines and U.S. Geological Survey

UNITED STATES GOVERNMENT PRINTING OFFICE, WASHINGTON : 1976

FOREWORD

In order to use mineral resource terms with precision and common understanding and to compare resource data effectively, a joint U.S. Bureau of Mines and U.S. Geological Survey work group developed a standardized, definitive, broadly applicable classification system to derive uniform, coordinated resource estimates. The principles of the system are given in Chapter A of this series (Bulletin 1450–A). This chapter presents the classification system for coal resources. Future chapters will present classification terms for other specific commodities.

Thomas V. Falkie

V. E. McKelvey

Thomas V. Falkie
Director, Bureau of Mines

V. E. McKelvey
Director, Geological Survey

CONTENTS

Foreword ----------
Introduction ----------
Classification system ----------
Glossary of coal classification terms ----------
Criteria for coal resource/reserve identification ----------

ILLUSTRATION

FIGURE 1. Classification of coal resources ----------

TABLE

TABLE 1. Coal resource/reserve criteria ----------

COAL RESOURCE CLASSIFICATION SYSTEM OF THE U.S. BUREAU OF MINES AND U.S. GEOLOGICAL SURVEY

INTRODUCTION

This method of classification is in conformity with the pro sions of the Joint Geological Survey-Bureau of Mines Resou Classification Agreement of November 21, 1973, covering all m eral resources and will be used in future resource/reserve stud on coal conducted by agencies of the Department of the Interi All resource and reserve estimates will be dated.

Within this system the term "coal resource" designates the es mated quantity of coal in the ground in such form that econor extraction is currently or potentially feasible. The "coal reser" is that part of the resource for which rank, quality, and quant have been reasonably determined and which is deemed to be m able at a profit under existing market conditions.

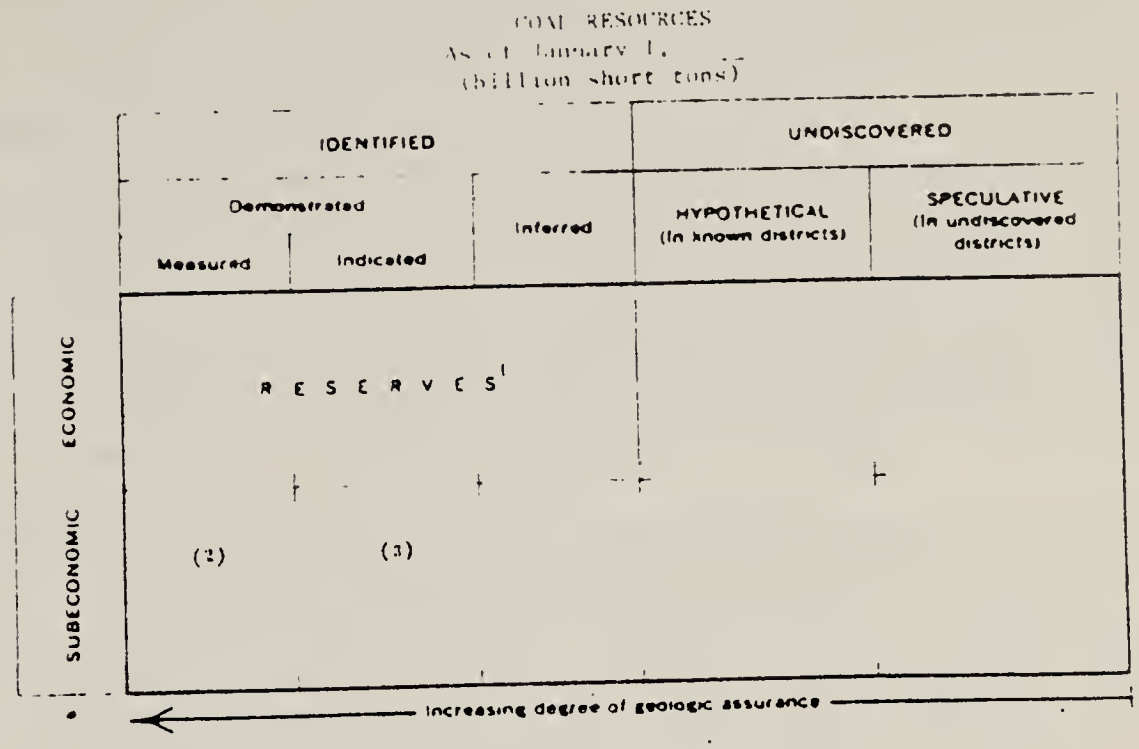
CLASSIFICATION SYSTEM

This system employs a concept by which coal beds are classif in terms of their degree of geologic identification and econor and technologic feasibility of recovery. In the following concept diagram (fig. 1) showing the relationship of the various fact involved, coal resources are located on the horizontal scale, creasingly to the left, according to their degree of geologi assurance of existence, and on the vertical scale, increasingly ward, according to their degree of economic and technologic fea bility of recovery.

The following general definitions of coal resource categories a amplified by the criteria for resource identification, which foll the Glossary. The criteria may be revised to reflect changing c ditions without affecting the definitions.

GLOSSARY OF COAL CLASSIFICATION TERMS

Resources.—Concentrations of coal in such forms that econor extraction is currently or may become feasible.



[1]Recovery factor = ___.

[2]Includes ___ billion tons of Reserve Base coal that are not currently minable. (see recovery factor).

[3]Includes ___ billion tons of Reserve Base that are not currently minable (see recovery factor).

Total Remaining Resources ___
Cumulative Production ___
Total Original Resources ___

Average production, (5 yr. period) _____ million short tons
Production, (most recent year) _____ million short tons

FIGURE 1.—Classification of coal resources.

Identified Resources.—Specific bodies of coal whose locatic rank, quality, and quantity are known from geologic eviden supported by engineering measurements.

Undiscovered Resources.—Unspecified bodies of coal surmised exist on the basis of broad geologic knowledge and theory.

Reserve Base.—That portion of the Identified Coal Resource fr which Reserves are calculated.

Reserve.—That portion of the Identified Coal Resource that c be economically mined at the time of determination. The serve is derived by applying a Recovery Factor to that co ponent of the Identified Coal Resource designated as t *Reserve Base.*

Recovery Factor.—The percentage of total tons of coal estima to be recoverable from a given area in relation to the to tonnage estimated to be in the Reserve Base in the ground.

Identified Subeconomic Resources.—The part of coal resourc that occurs in Demonstrated and Inferred Resources that not now minable economically.

Hypothetical Resources.—Undiscovered Coal Resources in be that may reasonably be expected to exist in known mini districts under known geologic conditions. In general, Hyp thetical Resources are in broad areas of coal fields whe points of observation are absent and evidence is from dista outcrops, drill holes, or wells. Exploration that confirms th existence and reveals quantity and quality will permit th reclassification as a Reserve or Identified Subeconon Resource.

Speculative Resources.—Undiscovered coal in beds that may occ either in known types of deposits in a favorable geologic s ting where no discoveries have been made, or in deposits th remain to be recognized. Exploration that confirms th existence and reveals quantity and quality will permit th reclassification as Reserves or Identified Subeconon Resources.

The following definitions are applicable to both the Reserve a Identified Subeconomic Resource components.

Measured.—Coal for which estimates of the rank, quality, a quantity have been computed, within a margin of error of l than 20 percent, from sample analyses and measureme from closely spaced and geologically well-known sample sit

Indicated.—Coal for which estimates of the rank, quality, a quantity have been computed partly from sample analy and measurements and partly from reasonable geologic p jections.

Demonstrated.—A collective term for the sum of coal in bo Measured and Indicated Resources and Reserves.

Inferred.—Coal in unexplored extensions of Demonstrated R sources for which estimates of the quality and size are ba on geologic evidence and projection.

Rank.—The classification of coals relative to other coals, accordi to their degree of metamorphism, or progressive alterati in the natural series from lignite to anthracite (Classificati of Coal by Rank, 1938, American Society for Testing Mate als, ASTM Designation D–388–38, p. 77–84).

Quality or Grade.—Refers to individual measurements such heat value, fixed carbon, moisture, ash, sulfur, phosphor major, minor, and trace elements, coking properties, pet logic properties, and particular organic constituents. The in

vidual quality elements may be aggregated in various wa to classify coal for such special purposes as metallurgic gas, petrochemical, and blending usages.

CRITERIA FOR COAL RESOURCE/RESERVE IDENTIFICATION

Estimates of the different classes of coal resources and reser are arbitrarily based upon three criteria: (1) thickness, rank, a quality of the coal bed, (2) depth of the coal bed, and (3) t proximity of the coal resource data upon which the estimate w based. Depth and thickness are criteria because they control e nomic and technologic feasibility of recovery. The criteria for ea class are described below and summarized in table 1 and will used in preparing all Department of the Interior coal resour reserve estimates from January 1, 1975, until further revised.

These criteria apply only to those coal bodies that are or will economically extractable by underground, surface, and/or in s methods. Coal thinner than 14 inches (35 cm) (anthracite a bituminous) and 30 inches (75 cm) (subbituminous and ligni and all coal deeper than 6,000 feet (1,800 m) is excluded. Th thinner and deeper coals will be considered at a later date. C containing more than 33 percent ash is excluded from resou and reserve estimates.

Identified Resources.—Include beds of bituminous coal and thracite 14 inches (35 cm) or more thick and beds of s bituminous coal and lignite 30 inches (75 cm) or more th that occur at depths to 6,000 feet (1,800 m), and whose ex ence and quantity have been delineated within specified grees of geologic assurance as measured, indicated, or inf red. Include also thinner and/or deeper beds that presen are being mined or for which there is evidence that they co be mined commercially.

Undiscovered Resources.—Include beds of bituminous coal a anthracite 14 inches (35 cm) or more thick and beds of s bituminous coal and lignite 30 inches (75 cm) or more th that are presumed to occur in unmapped and unexplo areas to depths of 6,000 feet (1,800 m).

Remaining Resources.—Includes the sum of the Identified a Undiscovered Resources as of the date of the estimate.

Cumulative Production.—Includes the sum of all production pr to the date of the estimate.

COAL RESOURCE CLASSIFICATION SYSTEM

TABLE 1.—Coal resource/reserve criteria

	Depth, Feet (Metres)	Thickness, Inche (Centimetres)
Total Resources and Undiscovered Resources.		
Anthracite and bituminous coal.	≤6,000 (1,800)	≥14 (35)
Subbituminous coal and lignite.	≤6,000 (1,800)	≥30 (75)
Identified Resources.[1]		
Anthracite and bituminous coal.	≤6,000 (1,800)	≥14 (35)
Subbituminous coal and lignite.	≤6,000 (1,800)	≥30 (75)
Reserve Base.[2]		
Anthracite and bituminous coal.	≤1,000 (300)	≥28 (70)
Subbituminous coal.	≤1,000 (300)	≥60 (150)
Lignite ----------	≤120 (40)	≥60 (150)
Reserves.		
Criteria same as Reserve Base but with Recovery Factor applied.		
Subeconomic Resources.[3]		
Anthracite and bituminous coal.	0–1,000 (300) 1,000 (300)–6,000 (1,800)	14 (35)–28 (70 ≥14 (35)
Subbituminous coal.	0–1,000 (300) 1,000 (300)–6,000 (1,800)	30 (75)–60 (150 ≥30 (75)
Lignite ----------	0–120 (40) 120 (40)–6,000 (1,800)	30 (75)–60 (150 ≥30 (75)

[1]Identified Resources are classified as Measured, Indicated, and Inferred according t degree of geologic assurance as described in the text.
[2]The Reserve Base includes some beds that are thinner and/or deeper than the g criteria permit, but that presently are being mined or are judged to be minable mercially at this time.
[3]Also includes currently nonrecoverable part of Reserve Base.

Total Original Resources.—Includes the sum of the Remain Resources and Cumulative Production as of the date of estimate.

Reserve Base.—Includes beds of bituminous coal and anthra 28 inches (70 cm) or more thick and beds of subbitumin coal 60 inches (150 cm) or more thick that occur at depth 1,000 feet (300 m). Includes also thinner and/or deeper b that presently are being mined or for which there is evide that they could be mined commercially at this time. Inclu

beds of lignite 60 inches (150 cm) or more thick which can surface mined—generally those that occur at depths greater than 120 feet (40 m).

Reserve.—Includes that portion of the Reserve Base that can mined at the time of classification (See Recovery Factor)

Recovery Factor.—On a national basis the estimated Recov Factor for the total Reserve Base is 50 percent. More prec recovery factors can be computed by determining the to coal in place and the total coal recoverable in any spec locale.

Subeconomic Resources.—Include all Identified Resources that not fall into the Reserve category. Include in this categ beds of bituminous coal and anthracite 14 inches (35 cm) 28 inches (70 cm) thick and beds of subbituminous coal inches (75 cm) to 60 inches (150 cm) thick that occur depths to 1,000 feet (300 m). Include also beds of bitumin coal and anthracite 14 inches (35 cm) or more thick and b of subbituminous coal 30 inches (75 cm) or more thick t occur at depths between 1,000 (300 m) and 6,000 feet (1,8 m). Include lignite beds 30 inches (75 cm) or more thick t cannot be surface mined—generally those that occur depths greater than 120 feet (40 m), and lignite beds inches (75 cm) to 60 inches (150 cm) thick that can be s face mined. Include the currently nonrecoverable portion the Reserve Base.

The following criteria are applicable to both the Reserve a Subeconomic Resources components:

Measured.—Resources are computed from dimensions revealed outcrops, trenches, mine workings, and drill holes. The poi of observation and measurement are so closely spaced and thickness and extent of coals are so well defined that the t nage is judged to be accurate within 20 percent of true t nage. Although the spacing of the points of observation nec sary to demonstrate continuity of the coal differs from reg to region according to the character of the coal beds, points of observation are no greater than ½ mile (0.8 k apart. Measured coal is projected to extend as a ¼-mile ((km) wide belt from the outcrop or points of observation measurement.

Indicated.—Resources are computed partly from specified me urements and partly from projection of visible data fo reasonable distance on the basis of geologic evidence. T

points of observation are ½ (0.8 km) to 1½ miles (2.4 km) apart. Indicated coal is projected to extend as a ½-mile (0.8-km) wide belt that lies more than ¼ mile (0.4 km) from the outcrop or points of observation or measurement.

Inferred.—Quantitative estimates are based largely on broad knowledge of the geologic character of the bed or region and where few measurements of bed thickness are available. The estimates are based primarily on an assumed continuation from Demonstrated coal for which there is geologic evidence. The points of observation are 1½ (2.4 km) to 6 miles (9.6 km) apart. Inferred coal is projected to extend as a 2¼-mile (3.6-km) wide belt that lies more than ¾ mile (1.2 km) from the outcrop or points of observation or measurement.

Hypothetical Resources.—Quantitative estimates are based on a broad knowledge of the geologic character of a coal bed or region. Measurements of coal thickness are more than 6 miles (9.6 km) apart. The assumption of continuity of a coal bed is supported only by geologic evidence.

Speculative Resources.—Quantitative estimates are based on geologic assumptions that undiscovered coal may occur in known types of deposits or in favorable geologic settings.

UNITED STATES
DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY
Conservation Division
345 Middlefield Road
Menlo Park, California 94025

RECEIVED
OCT 19 1976
Conservation Division
U.S. GEOLOGICAL SURVEY
Office of the Area Geologist
Menlo Park, California

October 19, 1976

Memorandum

To: Staff Advisor, Programs

From: Acting Conservation Manager, Western Region

Subject: Coal Lease Evaluation - Reserve Calculations

As with the CRO and ADP map, we are dealing with priorities. Coal interest and leasing activity are dormant at this time for Federal lands in the Western Region.

It is realistic to assume that similar requirements are necessary for the other leasable minerals, especially for phosphate and saline deposits in the Pacific Area. In fact, it would be appropriate for the Western Region to initiate resource and reserve category criteria and standards for phosphate and playa deposits, drawing from Bureau of Mines, industry, etc. sources and with the participation of the Mining Supervisor's office.

Formal project - no. MBO - yes.

Hillary A. Oden

Hillary A. Oden

cc: Area Geologist, Pacific

RECEIVED
U.S. Geological Survey
JUL 30 1976

JUL 27 1976

Conservation Division
Western Region
Menlo Park, Calif.

Memorandum

To: All Area and District Geologists, Central Region
All Area and District Mining Supervisors, Central Region

Through: Conservation Manager, Central Region

From: Acting Chief, Conservation Division

Subject: Revised plan for contracting of the CRO/CDP mapping program

As a result of discussions held between personnel of the Central Region and the Assistant Division Chief for Resource Evaluation, the plan for accomplishment of the CRO/CDP program as proposed in our memorandum of June 25, 1976, for contracting of these maps has been amended. A copy of the amended draft is enclosed.

Major changes in the amended draft include the following: (Geol. Div. considered a contractor)

1. All CRO and preliminary CDP maps would be contractor-generated utilizing all publicly available data.

2. Contractors would not input proprietary data in their compilations. CD personnel would be responsible for inventorying the proprietary data base and modifying all contractor-generated CRO maps as necessitated by proprietary data.

3. CD personnel would prepare the final CDP map based on the modified CRO map.

4. The contractor would, in addition, be required to plot, calculate, and report, in terms of Measured, Indicated, and Inferred categories, the Reserve Base and Reserves for federally owned coal lands within a KCLA.

5. The CRO maps will cover all lands within KCLA's, whereas the CDP maps would be prepared only for areas of federally owned coal within the KCLA's.

6. The role of CD personnel in monitoring of contracts and providing guidance at key points is expanded.

7. For this purpose, GD will remain in the role of a contractor for such CRO and preliminary CDP maps as it chooses to undertake.

In order to finalize these requirements for purposes of drafting a model contract, your review and comment on the enclosed draft should be directed to the Assistant Division Chief for Resource Evaluation, MS 640, no later than August 16.

In light of the added emphasis that adoption of these or similar requirements would place on contracting as a means of meeting our goals for CRO/CDP mapping, the need for a single coordinating body appears imperative. It is proposed that positions allocated in the supplemental coal budget be utilized to staff a task force to direct the CRO/CDP program. It is also recommended that this task force be administratively attached to the Central Region Manager's staff and receive guidance and report jointly to both the Conservation Manager, Central Region, and the Assistant Division Chief for Resource Evaluation on the progress of the program.

It is also anticipated that this task force would assume initial responsibility for negotiating contracts and should therefore be operational by September 1, 1976, if contracts are to be issued prior to the end of CY 1976. Your comments on this approach to managing the program would also be welcomed.

Russell G. Wayland

Acting Chief, Conservation Division

Enclosure

cc: CD file
Chief Geologist
Assistant Director, Energy and Mineral Resources
Conservation Manager, Western Region
Conservation Manager, Eastern Region
ESP Section
ADC/RE
C/BOE
RE chrons

CD:GTSpanski:LHGodwin:RLRioux:blb:7/23/76 860-7567

CRO/CDP PROGRAM

I. General Contract Requirements:

The contractor shall collect all publicly available data on coal resource occurrence within KCLA's and data which would influence the determination of coal resources occurring on lands in KCLA's. All maps and overlay masters shall be printed on a semi-transparent, stable, reproducible base media at a scale of 1:24,000 compatible for direct use with standard USGS topographic map series. The total contract effort shall be subdivided into 2 task areas with the following stipulated requirements and end-products. The contractor shall provide two complete sets of maps, overlays, and documents on a reproducible base and an additional quantity of copies as specified by the CD contract monitoring officer.

A. CRO maps (for public release):

1. Preliminary Data Compilation Phase.

Maps and tables to include all existing publicly available data on coal resources within the KCLA's. All items prepared in this phase shall be submitted to CD for review and comment prior to initiating next phase.

a. Base map showing (1) locations of resource data (outcrops, mine sites, wells, etc.) showing coal and noncoal unit thickness; (2) boundaries of federally owned coal areas; (3) boundaries of all Federal coal leases and permits identified by lease

number; (4) boundaries of KCLA's; (5) cadastral boundaries subdivided to the quarter of a quarter section or smallest legal subdivision.

b. Tables (with reference citations) containing (1) coal thickness data for each identified bed (% of minor partings, method of measurement, bed identifier); (2) coal quality (BTU, sulfur, ash, trace elements, and moisture content) by bed; (3) data on noncoal intervals effecting development potential determination (engineering properties, toxic chemical characteristics, mineralogical compositions).

c. Crossections showing correlation of all identified coal beds for all well or data points used for control.

2. Intermediate Data Compilation Phase.

CD personnel shall identify (1) those coal beds which are potentially recoverable by surface mining methods and those coal beds potentially recoverable by underground mining and/or in situ methods; (2) those coal beds for which isopahc maps are to be prepared; and (3) those additional beds which shall be included in reserve calculations without an isopach map being prepared. All items prepared during this phase are to be submitted to CD for review and comment prior to initiating the next phase.

a. Isopach map (showing burned and mined areas) for each coal bed or split, identified by name or appropriate bed identifier, and showing the Measured, Indicated, and Inferred zone boundaries.

b. Structure contour map for each coal bed or split from (2.a.), identified by name or appropriate bed identifier.

c. Isopach map for each noncoal interval overlying a coal bed or split from (2.a.) which is potentially recoverable by surface mining methods.

3. Final Data Compilation Phase.

CD personnel shall provide the contractor with guidance on selection of recovery factor. All items prepared in this phase shall be submitted to CD personnel for review and comment before initiating preparation of the Preliminary CDP map.

a. Recoverability factor overlay showing by zone the probable recovery rate(s) for each coal bed from (2.a.).

b. Mining ratio (yd^3 overburden/Ton coal) overlay for each coal bed from (2.a.) which is recoverable by surface methods (based only on thickness of immediately overlying noncoal interval and fraction of coal recoverable).

c. Addition of Measured, Indicated, and Inferred Coal Reserve Base and Reserves to coal isopach maps calculated for all federally owned coal and reported by section.

d. Composite columnar stratigraphic section covering the interval from surface to 10 feet below the base of the deepest identified coal showing all identified coal beds by name and indicating those beds considered in reserve calculations.

e. Descriptive narrative to include a brief discussion of the geology of the area, the coal quality (BTU, ash, trace element, and S content) and variations of quality, and characteristics of coal and noncoal units which effect minability or generate environmental problems.

B. Preliminary Coal Development Potential (CDP) map (not for public release):

A single overlay sheet with land grid showing the following information for federally owned coal within KCLA's exclusive of areas subject to current coal lease or permits. A quarter of a quarter section or smallest legal subdivision shall be the basic unit of designation. CD personnel shall provide guidance on selection of factors to be used to determine CDP limits. Preliminary CDP map drafts shall be submitted to CD personnel for review.

1. Surface minable coal areas: high, moderate, low potential for development, and areas of insufficient data.
2. Underground minable and/or in situ developable coal areas: high, moderate, low potential for development, and areas of insufficient data.

3. Statement of criteria given consideration in the assignment of development potential including: coal quality, coal thickness, overburden thickness, mining ratios, groundwater problems, availability of water, recoverability factor, engineering problems, environmental hazards, proximity of transportation, and other economic assessments.

II. Conservation Division Requirements:

A. Specifications and definitions:

CD personnel will provide the contractor with the following information for each KCLA and quadrangle contained therein.

1. Definition for terms: Reserve Base, Measured, Indicated, Inferred, Reserves, mining ratio, etc.
2. Stipulation of contour intervals to be used on isopach and structure contour maps, and mining ratio overlays.
3. Designation of coal beds to be considered in reserve calculations.
4. Designation of coal beds for which isopach maps are prepared.
5. Determination of coal beds potentially recoverable by surface mining methods and those to be mined by underground and/or in situ methods.
6. Provision of guidelines for assignment of recovery factors.

7. Provision of guidelines for the selection of criteria used in defining coal development potential.

B. Administration

CD personnel shall perform the following functions:

1. Monitor contractor's progress on a continuing basis and provide map completion priorities.
2. Coordinate contractor's access to CD (publicly available) data.
3. Review draft copies of contractor-generated maps for completeness.
4. Review and approve final revised CRO package submitted by the contractor and distribute copies to appropriate CD and BLM offices.
5. Review and approve preliminary CDP map submittals and distribute to CD offices for finalization.
6. Prepare and maintain in a current status a CD file copy of all contractor-generated information.

United States Department of the Interior

Geological Survey

GEOLOGICAL SURVEY

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JUN 28 1976
Conservation Division
Western Region
Menlo Park, Calif.

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JUN 22 1976
Conservation Division
U.S. GEOLOGICAL SURVEY
Menlo Park, California

Memorandum

To: All Area and District Geologists

Through: Conservation Manager, Central Region
Eastern Region
Western Region H. Gaudin

From: Chief, Conservation Division

Subject: Establishment of KCLA's in Accordance with Joint Geological Survey - Bureau of Mines Classification System for Coal Resources and Reserves, dated February 5, 1976

This memorandum modifies my instructions of December 1, 1969, as it applies to determination of "existence" of coal deposits for purposes of establishment of KCLA's. This modification is required as the result of changes in resource-reserve definition under the recent Joint Geological Survey - Bureau of Mines Classification System for Coal which was published as Geological Survey Bulletin 1450-B.

In current and future work toward the establishment of KCLA's "existence" of coal shall be in general equated to "identified resources" as defined under the GS-BM Classification System:

> "Specific bodies of coal whose location, rank, quality, and quantity are known from geologic evidence supported by engineering measurements. Includes beds of bituminous coal and anthracite 14 inches (35 cm) or more thick and beds of subbituminous coal and lignite 30 inches (75 cm) or more thick that occur at depths to 6,000 feet (1800 m), and whose existence and quantity have been delineated within specified degrees of geologic assurance as measured, indicated, or inferred. Include also thinner and/or deeper beds that presently are being mined or for which there is evidence that they could be mined commercially."

Identified resources for inclusion within a KCLA shall normally be no more than three miles from point of observation and measurement. However, coal lands may be included within a KCLA at distances greater than three miles from points of observation or measurement where geologic data strongly support persistence, thickness, and quality of coal.

Separate instructions have been issued for mineral land classification for retention (May 28, 1976) and will be issued for resource-reserve calculations for lease evaluation.

Acting Chief, Conservation Division

United States Department of the Interior

GEOLOGICAL SURVEY
RESTON, VIRGINIA 22092

JUN 22 1976

Memorandum

To: All Area and District Geologists
All Area and District Mining Supervisors

Through: Conservation Manager, Central Region
Eastern Region
Western Region

From: Acting Chief, Conservation Division

Subject: Resource-Reserve Calculations--Coal Lease Evaluation

This memorandum supersedes my instructions of June 18, 1973, with respect to methods of calculations of inplace reserves for coal, and supplements my memorandum of May 28, 1976, with respect to reserves and resources terminology for mineral land classification for retention purposes. In addition, a memorandum will be issued as to use of this system for establishment of KCLA's.

Area and District Geologists are required to provide current calculations of coal reserves inplace in Measured, Indicated, and Inferred categories for use by Area and District Mining Supervisors in calculating recoverable coal reserves. Demonstrated (Measured and Indicated) reserve data are used for purposes of establishing bonuses for competitive lease sales and advance accumulative royalties for leases to be issued or lease continuances, and for determination of accuracy of Measured and Indicated reserves for preference right lease applications. Such reserve determinations are required under current and proposed Federal regulations, and standard procedures must be followed in order to assure that our work will be legally valid. Inferred reserves will be used for inventory purposes only.

In order to meet our responsibilities in providing coal reserve information on Federal lands in a uniform, legally correct manner for use in competitive leasing, lease data systems, and overall Federal coal management programs, as opposed to mineral land classification for retention purposes, the following procedures will be followed:

1. Calculation of coal resources and reserves will follow usage employed in the Joint Geological Survey - Bureau of Mines Classification System for Coal Resources and Reserves as approved by the Director of the Geological Survey on February 5, 1976 (enclosed).

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The following definitions of Measured, Indicated, and Inferred will be employed for these purposes:

a. Measured coal: coal for which estimates of rank, quality, and quantity have been computed from sample analyses and measurements from closely spaced and geologically well-known sample sites. Measured coal is computed from dimensions revealed in outcrops, trenches, mine workings, and drill holes. The points of observation and measurement are so closely spaced and the thickness and extent of coals are so well defined that the tonnage is judged to be accurate within 20 percent of true tonnage. Although the spacing of the points of observation necessary to demonstrate continuity of the coal differs from region to region according to the character of the coal beds, the points of observation are no greater than 1/2 mile (.8 km) apart. Measured coal is projected to extend as a 1/4 mile (.4 km) wide belt from the outcrop or points of observation or measurement.

b. Indicated coal: coal for which estimates of the rank, quality, and quantity have been computed partly from sample analyses and measurements and partly from projection of visible data for a reasonable distance on the basis of geologic evidence. The points of observation are 1/2 (.8 km) to 1-1/2 miles (2.4 km) apart. Indicated coal is projected to extend as a 1/2 mile (.8 km) wide belt that lies more than 1/4 mile (.4 km) from the outcrop or points of observation or measurement.

c. Inferred coal: coal for which quantitative estimates are based largely on broad knowledge of the geologic character of the bed or region and where few measurements of bed thickness are available. The estimates are based primarily on an assumed continuation from Demonstrated coal for which there is geologic evidence. The points of observation are 1-1/2 (2.4 km) to 6 miles (9.6 km) apart. Inferred coal is projected to extend as a 2-1/4 mile (3.6 km) wide belt that lies more than 3/4 mile (1.2 km) from the outcrop or points of observation or measurement.

It should be noted that the spacing of points of observation and measurement are specific and mandatory for each category (Measured, Indicated, Inferred) and must be followed.

2. The Reserve Base will be calculated by the appropriate District and Area Geologist. The Reserve Base is defined as that portion of the Identified Coal Resource from which Reserves are calculated. It includes beds of bituminous coal and anthracite 28 inches (70 cm) or more thick and beds of subbituminous coal 60 inches (150 cm) or more thick that occur at depths to 1,000 feet (300 m). It includes also thinner and/or deeper beds than presently are

being mined or for which there is evidence that they could be mined commercially at this time. Includes beds of lignite 60 inches (150 cm) or more thick which can be surface mined--generally those that occur at depths no greater than 120 feet (40 m).

3. The Reserve Base will be divided by the geologist into Measured, Indicated, and Inferred categories and expressed as tons, depth, and quality ranges for each bed in a given area outlined on a map or plat indicating extent.

4. Area and District Geologists will provide Area and District Mining Supervisors with a map or plat indicating the area involved, thickness, quality, and depth ranges as well as the calculated inplace tonnage for each tonnage category.

5. Area and District Mining Supervisors will calculate Reserves by elimination of coal determined to be unminable due to factors of current technology, safety, economic conditions, and recoverability, and will apply an appropriate recovery factor to workable beds. The figures thus obtained will be reported as Measured, Indicated, and Inferred Reserves. The difference between the Reserve Base calculated by the geologist and the Reserves calculated by the mining engineer is the amount of coal determined to be unminable.

Note that this system for reserve determination represents substantial modification of previous Conservation Division reserve determination methods. It conforms with the recent Joint Geological Survey - Bureau of Mines Classification System which must be followed by all agencies of the Department of the Interior. Conservation Division personnel charged with coal reserve-resource determinations should study and familiarize themselves with the contents of this document which was also published as Geological Survey Bulletin 1450-B.

Any serious difficulties encountered in the application of these procedures should be reported promptly to Division headquarters.

Robert F Evans
Acting Chief, Conservation Division

Enclosure

SUMMARY OF MAJOR REQUIREMENTS OF JOINT GEOLOGICAL SURVEY - BUREAU OF MINES COAL CLASSIFICATION SYSTEM

1. Coal deposits can be classified as reserves only if they are deemed minable at a profit.

2. Because profitability varies with changing economic conditions, all reserve-resource estimates must be dated.

3. The reserve base as defined under this classification must be reduced by a recovery factor in order to establish the quantity to be reported as reserves.

4. The reserve base, except under specified economic circumstances, includes anthracite, bituminous, and subbituminous coal that occurs at depths to 1,000 feet (300 m). Only those lignite deposits which can be surface mined, generally occurring at a depth no greater than 120 feet (40 m) can be included in the reserve base.

5. Rank of coal reserves or resources is to be determined in accordance with ASTM Designation D-388-38, p. 77-84 (1938).

6. Quality of a coal deposit must be considered before it can be included in a reserve or resource category, but no standards of quality are specified other than ash content. No coal containing more than 33 percent ash may be included in reserve-resource estimates.

7. No coal deposit may be included in either the reserve or resource category if it occurs at a depth greater than 6,000 feet (1800 m). These coals will be considered at a later date.

8. Drill hole spacing requirements for reserves and resources are no more than 1/2 mile (.8 km) apart for measured coal, 1-1/2 miles (2.4 km) for indicated coal, and 6 miles (9.6 km) for inferred coal.

9. Measured coal must be known accurately within 20 percent.

0. No percentage of accuracy requirement is stipulated for indicated or inferred reserves.

FEB 5 1976

Memorandum

To: Acting Assistant Secretary for Energy and Minerals

From: Director, Geological Survey
Director, Bureau of Mines

Subject: Joint agreement defining coal resource and reserve classification terms for Department of Interior resource estimates

In order to use coal resource terms with precision and common understanding and to compare resource data effectively, a joint Geological Survey and Bureau of Mines work group developed a standardized, definitive, broadly applicable classification system to coordinate the derivation of official resource estimates. The results of the work group collaboration are presented herewith. They have (1) agreed on a classification system, (2) compiled a glossary of resource terms, and (3) established criteria for resource/reserve identification.

V. E. McKelvey

Director, Geological Survey

Thomas V. Falkie

Director, Bureau of Mines

Enclosure
cc: Bureau of Mines
General Files (114)
Director's Chron (114)
Division (911)
OER Rdy
OER Files
BCR Chron (956)
Pending
CD:CHWood:bp; 1/26/76 860-7734

JOINT GEOLOGICAL SURVEY-BUREAU OF MINES CLASSIFICATION SYSTEM FOR COAL RESOURCES AND RESERVES

This method of classification is in conformity with the provisions of the Joint Geological Survey-Bureau of Mines Resource Classification Agreement of November 21, 1973, covering all mineral resources and will be used in future resource-reserve studies on coal conducted by agencies of the Department of the Interior. All resource and reserve estimates will be dated.

Within this system the term "coal resource" designates the estimated quantity of coal in the ground in such form that economic extraction is currently or potentially feasible. The "coal reserve" is that part of the resource for which rank, quality, and quantity have been reasonably determined and which is deemed to be minable at a profit under existing market conditions.

Classification System

This system employs a concept by which coal beds are classified in terms of their degree of geologic identification and economic and technologic feasibility of recovery. In the following conceptual diagram showing the relationship of the various factors involved, coal resources are located on the horizontal scale, increasingly to the left, according to their degree of geological assurance of existence, and on the vertical scale, increasingly upward, according to their degree of economic and technologic feasibility of recovery.

The following general definitions of coal resource categories are amplified by the criteria for resource identification which follows this Glossary. The criteria may be revised to reflect changing conditions without affecting the definitions.

Glossary of Coal Classification Terms

Resources - Concentrations of coal in such forms that economic extraction is currently or may become feasible.

Identified Resources - Specific bodies of coal whose location, rank, quality, and quantity are known from geologic evidence supported by engineering measurements.

Undiscovered Resources - Unspecified bodies of coal surmised to exist on the basis of broad geologic knowledge and theory.

Reserve Base - That portion of the Identified Coal Resource from which Reserves are calculated.

Reserve - That portion of the Identified Coal Resource that can be economically mined at the time of determination. The reserve is derived by applying a Recovery Factor to that component of the Identified Coal Resource designated as the Reserve Base.

Recovery Factor - The percentage of total tons of coal estimated to be recoverable from a given area in relation to the total tonnage estimated to be in the Reserve Base in the ground.

Identified-Subeconomic Resources - The part of coal resources that occurs in Demonstrated and Inferred Resources that is not now minable economically.

Hypothetical Resources - Undiscovered Coal Resources in beds that may reasonably be expected to exist in known mining districts under known geologic conditions. In general, Hypothetical Resources are in broad areas of coal fields where points of observation are absent and evidence is from distant outcrops, drill-holes, or wells. Exploration that confirms their existence and reveals quantity and quality will permit their reclassification as a Reserve or Identified-Subeconomic Resource.

Speculative Resources - Undiscovered coal in beds that may occur either in known types of deposits in a favorable geologic setting where no discoveries have been made, or in deposits that remain to be recognized. Exploration that confirms their existence and reveals quantity and quality will permit their reclassification as Reserves or Identified-Subeconomic Resources.

The following definitions are applicable to both the Reserve and Identified-Subeconomic Resource components.

Measured - Coal for which estimates of the rank, quality, and quantity have been computed, within a margin of error of less than 20 percent, from sample analyses and measurements from closely spaced and geologically well-known sample sites.

Indicated - Coal for which estimates of the rank, quality, and quantity have been computed partly from sample analyses and measurements and partly from reasonable geologic projections.

Demonstrated - A collective term for the sum of coal in both Measured and Indicated Resources and Reserves.

Inferred - Coal in unexplored extensions of Demonstrated Resources for which estimates of the quality and size are based on geologic evidence and projection.

Rank - The classification of coals relative to other coals, according to their degree of metamorphism, or progressive alteration, in the natural series from lignite to anthracite. (Classification of Coal by Rank, 1938, Amer. Soc. Test. Materials, ASTM Designation D-388-38, p. 77-84).

Quality or Grade - Refers to individual measurements such as heat value fixed carbon, moisture, ash, sulfur, phosphorus, major, minor, and trace elements, coking properties, petrologic properties, and particular organic constituents. The individual quality elements may be aggregated in various ways to classify coal for such special purposes as metallurgical, gas, petrochemical, and blending usages.

Criteria for Coal Resource/Reserve Identification

Estimates of the different classes of coal resources and reserves are arbitrarily based upon three criteria -- (1) thickness, rank, and quality of the coal bed, (2) depth of the coal bed, and (3) the proximity of the coal resource data upon which the estimate was based. Depth and thickness are criteria because they control economic and technologic feasibility of recovery. The criteria for each class are described below and summarized in Table I and will be used in preparing all Department of the Interior coal resource/reserve estimates from January 1, 1975, until further revised.

These criteria apply only to those coal bodies that are or will be economically extractable by underground, surface, and/or in situ methods. Coal thinner than 14 inches (35 cm) (anthracite and bituminous) and 30 inches (75 cm) (subbituminous and lignite) and all coal deeper than 6,000 feet (1800 m) is excluded. These thinner and deeper coals will be considered at a later date. Coal containing more than 33 percent ash is excluded from resource and reserve estimates.

Identified Resources - Include beds of bituminous coal and anthracite 14 inches (35 cm) or more thick and beds of subbituminous coal and lignite 30 inches (75 cm) or more thick that occur at depths to 6,000 feet (1800 m), and whose existence and quantity have been delineated within specified degrees of geologic assurance as measured, indicated, or inferred. Include also thinner and/or deeper beds that presently are being mined or for which there is evidence that they could be mined commercially.

Undiscovered Resources - Include beds of bituminous coal and anthracite 14 inches (35 cm) or more thick and beds of subbituminous coal and lignite 30 inches (75 cm) or more thick that are presumed to occur in unmapped and unexplored areas to depths of 6,000 feet (1800 m).

Remaining Resources - Includes the sum of the Identified and Undiscovered Resources as of the date of the estimate.

Cumulative Production - Includes the sum of all production prior to the date of the estimate.

Total Original Resources - Include the sum of the Remaining Resources and Cumulative Production as of the date of the estimate.

Reserve Base - Includes beds of bituminous coal and anthracite 28 inches (70 cm) or more thick and beds of subbituminous coal 60 inches (150 cm) or more thick that occur at depths to 1,000 feet (300 m). Includes also thinner and/or deeper beds that presently are being mined or for which there is evidence that they could be mined commercially at this time. Includes beds of lignite 60 inches (150 cm) or more thick which can be surface mined--generally those that occur at depths no greater than 120 feet (40 m).

Reserve - Includes that portion of the Reserve Base that can be mined at the time of classification. (See Recovery Factor)

Recovery Factor - On a National basis the estimated Recovery Factor for the total Reserve Base is 50 percent. More precise recovery factors can be computed by determining the total coal in place and the total coal recoverable in any specific locale.

Subeconomic Resources - Include all Identified Resources that do not fall into the Reserve category. Include in this category beds of bituminous coal and anthracite 14 inches (35 cm) to 28 inches (70 cm) thick and beds of subbituminous coal 30 inches (75 cm) to 60 inches (150 cm) thick that occur at depths to 1,000 feet (300 m). Include also beds of bituminous coal and anthracite 14 inches (35 cm) or more thick and beds of subbituminous coal 30 inches (75 cm) or more thick that occur at depths between 1,000 (300 m) and 6,000 feet (1800 m). Include lignite beds 30 inches (75 cm) or more thick that cannot be surface mined--generally those that occur at depths greater than 120 feet (40 m), and lignite beds 30 inches (75 cm) to 60 inches (150 cm) thick that can be surface mined. Include the currently nonrecoverable portion of the Reserve Base.

The following criteria are applicable to both the Reserve and Subeconomic Resources components.

Measured - Resources are computed from dimensions revealed in outcrops, trenches, mine workings, and drill holes. The points of observation and measurement are so closely spaced and the thickness and extent of coals are so well defined that the tonnage is judged to be accurate within 20 percent of true tonnage. Although the spacing of the points of observation necessary to demonstrate continuity of the coal differs from region to region according to the character of the coal beds, the points of observation are no greater than 1/2 mile (.8 km) apart. Measured coal is projected to extend as a 1/4 mile (.4 km) wide belt from the outcrop or points of observation or measurement.

Indicated - Resources are computed partly from specified measurements and partly from projection of visible data for a reasonable distance on the basis of geologic evidence. The points of observation are 1/2 (.8 km) to 1 1/2 miles (2.4 km) apart. Indicated coal is projected to extend as a 1/2 mile (.8 km) wide belt that lies more than 1/4 mile (.4 km) from the outcrop or points of observation or measurement.

Inferred - Quantitative estimates are based largely on broad knowledge of the geologic character of the bed or region and where few measurements of bed thickness are available. The estimates are based primarily on an assumed continuation from Demonstrated coal for which there is geologic evidence. The points of observation are 1 1/2 (2.4 km) to 6 miles (9.6 km) apart. Inferred coal is projected to extend as a 2 1/4 mile (3.6 km) wide belt that lies more than 3/4 mile (1.2 km) from the outcrop or points of observation or measurement.

Hypothetical Resources - Quantitative estimates are based on a broad knowledge of the geologic character of a coal bed or region. Measurements of coal thickness are more than 6 miles (9.6 km) apart. The assumption of continuity of a coal bed is supported only by geologic evidence.

Speculative Resources - Quantitative estimates are based on geologic assumptions that undiscovered coal may occur in known types of deposits or in favorable geologic settings.

TABLE 1. COAL RESOURCE-RESERVE CRITERIA

	epth--Feet (Meters)	Thickness--Inches (Ce meters)
Total Resources and Undiscovered Resources		
Anthracite and Bituminous Coal	6,000 (1800) or less	14 (35) or more
Subbituminous Coal and Lignite	6,000 (1800) or less	30 (75) or more
Identified Resources		
Anthracite and Bituminous Coal	6,000 (1800) or less	14 (35) or more
Subbituminous Coal and Lignite	6,000 (1800) or less	30 (75) or more
Reserve Base		
Anthracite and Bituminous Coal	1,000 (300) or less	28 (70) or more
Subbituminous Coal	1,000 (300) or less	60 (150) or more
Lignite	120 (40) or less	60 (150) or more
Reserves		
Criteria same as Reserve Base but with Recovery Factor applied.		
Subeconomic Resources		
Anthracite and Bituminous Coal	0 - 1,000 (300)	14 (35) - 28 (70)
	1,000 (300) - 6,000 (1800)	14 (35) or more
Subbituminous Coal	0 - 1,000 (300)	30 (75) - 60 (150)
	1,000 (300) - 6,000 (1800)	30 (75) or more
Lignite	0 - 120 (40)	30 (75) - 60 (150)
	120 (40) - 6,000 (1800)	30 (75) or more
Also includes currently nonrecoverable part of Reserve Base.		

The Reserve Base includes some beds that are thinner and/or deeper than the general criteria permit, but that presently are being mined or are judged to be minable commercially at this time.

Identified Resources are classified as Measured, Indicated, and Inferred according to the degree of geologic assurance as described in the text.

1012 Bartlett Building
215 W. Seventh St.
Los Angeles 14, Calif.

September 29, 1961

Memorandum

To: District Geologist, Taft
District Geologist, Anchorage

From: Regional Geologist, Pacific Coast Region

Subject: Coal classification - thickness determination

Following an exchange between the Chief and the Regional Geologist at Great Falls, the following further determination is added to classification standards:

1. In a coal bed with one or several thin partings the effective thickness is equal to the total thickness minus the sum of the thicknesses of the partings.

2. In a coal bed with many thin partings the procedure in (1) is followed unless the thickness of the partings exceeds the thickness of the interbedded coals, in which case the entire sequence of coal with partings is deducted. For example, if a 2-foot bed of coal is underlain by one foot of alternating layers of coal and shale in which the shale thickness exceeds the coal, and this is underlain by 4 feet of coal, the effective thickness will be 6 feet rather than 5 feet.

Mr. Duncan has not yet approved the proposed reduction in minimum heat value from 6000 Btu (air dried) to 4500 Btu (as received). It may be noted, however, that the lower value approximates the higher heat value when computed on an air dried basis. You will use 6000 Btu, air dried, as the minimum heat value until further notice.

(sgnd. J.C.Miller)

R. G. Wayland

Standardized interpretations of Suggested Rules for Calculating and Reporting Coal Reserves to be used by New Mexico-Southern Colorado projects.

A. Definition of coal bed: The Suggested Rules do not formally define a coal "bed"; however, a definition is implied in paragraph 7A: "Beds and parts of beds made up of alternating thin layers of coal and parting shall be omitted if the partings make up more than one-half the total thickness . . . or if the ash content exceeds 33 percent." Paraphrasing this, a coal bed, for purposes of reserve calculations, may be defined as a stratigraphic interval composed of more than 50 percent coal, and of which the uppermost and lowermost layers are coal. Bony coal (high ash content, but less than 33% ash) is classed as coal; bone (ash content greater than 33%) is excluded. In complex coal sequences with many alternations of coal and parting, the coal bed as defined above may be further analyzed into two or more predominantly coal benches separated by predominantly noncoal simple or compound partings, and the sum of the thicknesses of the predominantly coal benches may be used as the effective thickness of the total coal bed. It is realized that there may be a considerable discrepancy between the thickness thus established and the thickness actually minable under present mining practice, but the geologist ordinarily is in no position to judge what portion will be extractable when the deposit is eventually exploited.

B. Lateral continuity of coal beds: The lateral continuity of coal beds at the outcrop is determined, if possible, by visual tracing or by correlation of discontinuous outcrops on the basis of geologic evidence. In some cases, geologic evidence of lateral continuity may not exist, or may not be obtainable with our present basic knowledge and techniques.

1. Where lateral continuity has been proven by visual tracing or by correlation of very closely spaced observations, this continuity should be indicated by solid outcrop lines on the map and by solid correlation lines between the corresponding columnar coal sections.

2. Where lateral continuity is indicated by geologic evidence, but where possibility of error exists, lines consisting of long dashes should be used on the map* and on the series of columnar sections.

* Experience has shown that it is frequently impracticable to differentiate the types of outcrop lines in drafting the geologic map. Exceptions may, of course, be made in such cases.

3. Where no geologic evidence or obtainable geologic evidence as to continuity exists, the position of outcrop of the approximate stratigraphic horizon of the coal bed should be indicated on the geologic map by a line consisting of short dashes and extending up to a maximum of 1/2 mile in either direction from the point of observation. On the series of columnar coal sections, the lack of known continuity should be indicated by a few short dashes extending in either direction from the corresponding coal section, and ending in question marks.

4. Where continuity has been indicated by solid or long-dashed lines on the map, as specified in paragraphs 1 and 2 above, termination of such lines shall indicate a pinching-out of the bed or a reduction in thickness below the established minimum for the rank of coal involved. This should be documented on the line of columnar coal sections by columnar sections which bracket the stratigraphic horizon of the coal bed and show its submarginal thickness or absence.

   (a) If the precise geographic locality where the bed terminates or reaches submarginal thickness is known, the solid or long-dashed outcrop line shall end at that point.

(b) If the point where the bed terminates or reaches submarginal thickness is known only to be somewhere between two points of observation, the cut-off point should be determined by interpolation, and the solid or long-dashed outcrop line shall terminate at the point so determined.

(c) Where geologic evidence does not permit determination of a cut-off point by direct observation or interpolation, i.e., where the continuity and thickness of the bed beyond a terminal point of observation can not or has not been observed, the solid or long-dashed outcrop line should be extended only to the extreme point of observation, and a short-dashed line should be used to indicate the position of outcrop of the approximate stratigraphic horizon of the coal bed for a distance of up to a maximum of 1/2 mile beyond the last point of observation.

(d) Changes from one thickness category to another along a mapped outcrop line should be indicated as follows:

half arrow points enclose coal more than 14 inches thick for bituminous and anthracite, more than 30 inches thick for lignite and subbituminous; light arrow points enclose coal more than 28 inches thick for bituminous and anthracite, more than 60 inches thick for lignite and subbituminous; and solid arrow points enclose coal more than 42 inches thick for bituminous and anthracite, more than 120 inches thick for lignite and subbituminous.

C. Calculation of reserves: The procedures as outlined in the Suggested Rules shall be followed, with the following interpretations:

1. A letter dated November 26, 1948, from Paul Averitt to R. P. Bryson, which is presumably officially supplemental to the Suggested Rules, contains the following statement concerning "measured" coal: "One single, isolated point of observation about occurrence and thickness of coal, not supported by other information . . . entitles the estimator to assume a circle of 1/4 mile radius about the point of information." Paragraph 4B of the Suggested Rules contains the statement: "An isolated drill hole . . . may be considered to determine an area of coal of all classes extending for a radius of 1/2 mile around the hole." By subsequent informal agreement it has been agreed that the smaller circle shall represent "measured" coal and the additional area within the larger circle shall represent "indicated" coal. It has also been agreed that the 1/4 mile and 1/2 mile radii shall be considered maxima, and the estimator may reduce these lengths on the basis of his general knowledge of the habit of coal beds in the area.

   In accordance with these rules, as amended, a single point of observation on a coal bed, the lateral continuity of which cannot or has not been determined, shall be considered to be representative of those portions of circles of up to 1/4 mile and 1/2 mile radius described about the point of observation and lying behind the outcrop of the stratigraphic horizon of the coal bed. (See paragraph B-3, above.)

2. Where the continuity of a bed has been established and the bed is represented on the map by a solid or long-dashed outcrop line, and cut-off points have been established (as outlined in paragraphs B-4-(a) & (b)),

the area assumed to be underlain by the bed shall be determined by the standard semicircular construction as outlined in paragraph 7B of the Suggested Rules.

(a) Constructions based on solid outcrop lines shall determine areas of "measured" coal.

(b) Constructions based on long-dashed outcrop lines shall determine areas of "indicated" coal, except that each point of observation along the long-dashed outcrop line shall be considered to represent "measured" coal under a semicircular area of up to 1/4 mile radius about the point of observation.

3. Where the continuity of the bed has been only partially established (see paragraph B-4-(c), above), either of the following two procedures may be followed:

(a) The estimator may, on the basis of observed thinning or general knowledge of the habit of coal beds in his area, extrapolate the known data to a cut-off, and determine area of coal by the standard semicircular constructions.

(b) If the estimator has no basis for predicting the continuity and thickness of the bed beyond terminal points of observation, he may use the procedure outlined in Appendix I.

(c) In cases where a cut-off point can be determined at one end of the outcrop but cannot be determined at the other end, a combination of the conventional semicircular construction and the construction outlined in Appendix I may be used.

4. "Inferred" coal, as defined in the Suggested Rules, falls into two categories:

(a) Coal in beds for which there is "geologic evidence of continuity" but on which there are "few, if any, measurements". The spacing

of observations in this case presumably exceeds 1½ miles (the general spacing for "indicated" coal), and this category would embrace:

(1) Coal in areas where only widely-spaced observations of the beds have been made but where the stratigraphic associations of the beds are uniform over wide areas, permitting the determination of continuity by correlation.

(2) Coal in areas where outcrops of clinker, or "burned coal", can be traced for distances of more than 1½ miles but where no thickness measurements of the coal can be obtained.

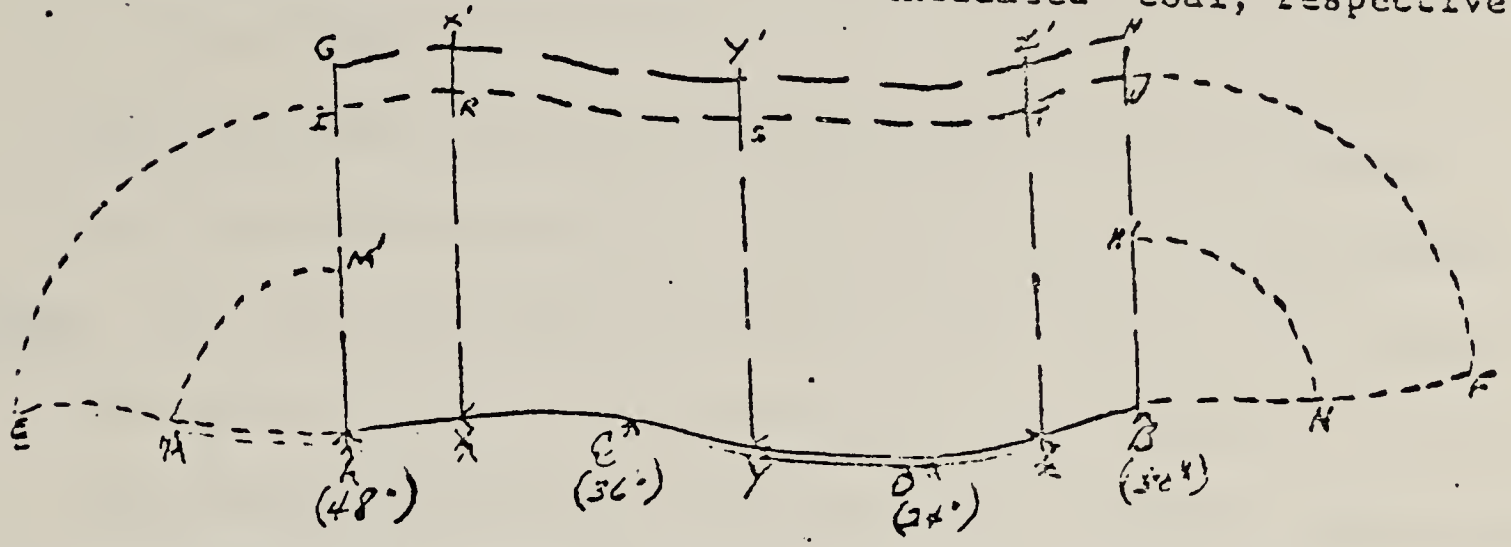
(b) Coal underlying those portions of the standard semicircular constructions that lie more than 2 miles in from the outcrop. In this case, of course, the bed must have a demonstrated continuity of more than 4 miles along the outcrop before any "inferred" coal can be calculated.

Appendix I

Procedure to be followed in estimating coal reserves in cases where the partial extent of a coal bed at the outcrop is determined, but the continuity and thickness of the bed can not be predicted beyond the terminal points of observation.

1. From the two terminal points of observation draw lines normal to the direction of the outcrop and of a length equal to one-half the mapped length of outcrop.
2. Similarly draw parallel lines of the same length through each interpolated point of change of thickness-category (see paragraph B-4-d).
3. Connect the ends of these lines with a smooth line which parallels the outcrop line.
4. If applicable, draw in smooth lines parallel to the outcrop and 1/2 mile and 2 miles in therefrom, to indicate limits of "measured" and "indicated" coal, respectively.
5. The total area is thus divided into a number of smaller areas. The "reliability category" of each area is determined from the type of outcrop line (solid or long-dashed) to which it is related, and the arbitrary distance-from-outcrop limits of "measured" and "indicated" coal. Where isopaching is impracticable, the "thickness category" of the unit area is determined by the transverse lines described in paragraph 2 of this appendix, and the thickness figure to be used for calculation shall be determined by averaging measurements along the segment of outcrop to which it is related.

6. In order to be consistent with other construction, circular area of up to 1/4-mile and up to 1/2-mile radius should be described about the terminal points of observation to define additional areas of "measured" and "indicated" coal, respectively.



A, B, C, D are points of observation along the outcrop of a coal bed of proven continuity--continuity and thickness not predictable beyond points A and B.

X, Y, Z are interpolated points (42", 28", and 38" thickness, respectively) of change from one thickness category to another (for bituminous coal in this case).

AE and BF are 1/2-mile extensions of the outcrop of the stratigraphic horizon of the coal bed.

LJ is line defining the limit of "measured" coal and is drawn 1/2 mile in from the outcrop.

MM^1 and NN^1 in 1/4-mile radius area described about A and B, respectively. Estimator has discretion to reduce the radius.

EI and FJ are 1/2-mile-radius area described about A and B, respectively. Estimator may reduce this radius, also.

AG, BH, XX^1, YY^1 and ZZ^1 are erected normal to the trend of the outcrop and of a length equal to one-half the distance AB.

Examples of calculations:

The figure XRSY represents "measured" coal of

$$\frac{42" - 36" - 28"}{3} = 35" \text{ thickness}$$

The figure RX^1Y^1S represents "indicated" coal of the same thickness as in XRSY.

The figure AMM^1 represents "measured" coal of 48" thickness.

The figure EGM^1M represents "indicated" coal of 48" thickness.

Notes: (1) If, in the above construction, the outcrop line AB were a long-dashed line, the area of "measured" coal would be limited to that formed by describing semicircles up to 1/4-mile radius about each point of observation (A, B, C, and D).

(2) The example given above assumes that data are inadequate for conventional isopaching. Where isopaching is possible, isopach lines with values corresponding to those at X, Y, and Z should replace the lines XX^1, YY^1, and ZZ^1.

U.S. GEOLOGICAL SURVEY

January 1, 1959

SUGGESTED RULES FOR CALCULATING AND REPORTING COAL RESERVES

The following rules and definitions are designed to combine the best features of the procedures used in preparing older published estimates of coal reserves, with modifications based on the recent experience of a number of geologists and engineers. They are intended to produce a reasonable uniformity of thinking and procedure on the part of Survey coal geologists, so that coal reserve estimates prepared for different areas can be combined in County, State, and National totals. Obviously, all the generalized statements contained herein do not apply rigidly to all coal-bearing areas and one should select, with modifications, as required, procedures that best apply to his local areas.

1. Rank of coal.--Where coal of more than one rank is covered by an individual report, the reserve data shall be reported separately for coal in each of the major rank categories listed below according to specifications of the American Society for Testing Materials (D-388-38):

A. Lignite
B. Subbituminous coal
C. Medium and high volatile bituminous coal
D. Low volatile bituminous coal
E. Anthracite and semi-anthracite

2. Overburden.--Reserve data shall be reported according to the amount of overburden on the coal in three categories as follows:

A. 0 to 1,000 Feet
B. 1,000 to 2,000
C. 2,000 to 3,000

Wherever possible, reserves of strippable coal shall be calculated in three additional categories as follows:

A. 0 to 60 Feet
B. 60 to 90
C. 90 to 120

3. Weight of coal.--Where other precise data are not available, the following values shall be assigned as the weight of coal:

Anthracite and semi-anthracite	2,000 short tons per acre foot
Bituminous coal	1,800 " " " " "
Subbituminous coal	1,770 " " " " "
Lignite	1,750 " " " " "

4. Size of unit area.--In order to be useful for future planning coal reserve should be calculated and reported for relatively small geographic areas. Townships, or 7½-minute and 15-minute quadrangles are satisfactory. Regardless of the minimum unit area selected the calculations should permit subtotals for counties.

5. Major classes of reserves.--On the basis of the relative reliability of data on which the calculations are based, coal reserves shall be reported in three separate classes as follows:

A. Measured coal.--Measured coal is coal for which tonnage is computed from dimensions revealed in outcrops, trenches, mine workings, and drill holes. The points of observation and measurement are so closely spaced, and the thickness and extent of the coal is so well defined that the computed tonnage is judged to be accurate within 20 percent or less of the true tonnage. The limits of accuracy of the estimate should be stated. Although the spacing of the points of observation necessary to demonstrate continuity of coal will vary in different regions according to the habit of the coal beds, the points of observation are, in general, of the order of ½-mile apart. The outer limit of a block of Measured coal, therefore, shall be of the order of ¼-mile from the last point of positive information (i.e., roughly one-half the distance between points of observation).

Where no data are available other than measurements along the outcrop, but where the continuity of the outcrop is measured in miles and suggests the presence of coal at great distances in from the outcrop, a smooth line drawn roughly ½ mile in from the outcrop, shall be used to mark the limit under cover of a block of coal that can also be classed as Measured.

B. Indicated coal.--Indicated coal is coal for which tonnage is computed partly from specific measurements, and partly from projection of visible data for a reasonable distance on geologic evidence. In general, the points of observation are of the order of 1 mile apart, but may be as much as 1½ miles for beds of known geologic continuity. For example, if drilling on ½-mile centers has proved up a block of measured coal of fairly uniform thickness and extent, the area of measured coal is, according to the judgment of the estimator, larger than the actual area of drilling by as much as ¼ mile on all sides. If from geologic evidence the bed is believed to have greater continuity, the area of Measured coal is surrounded by a belt of Indicated coal, which, according to the judgment of the appraiser, may be as much as 1½ miles wide.

Where there are no data available other than measurements along the outcrops, but where the continuity of the outcrop is measured in miles and suggests the presence of coal at great distances in from

the outcrop, two lines drawn roughly parallel to the outcrop, one ½ mile in from the outcrop, and one 2 miles in from the outcrop, define a block of coal that may be classed as Indicated.

The Measured and Indicated categories may be combined if the amount of Measured reserves is small or if required for reasons of policy.

C. Inferred coal.--Inferred coal is coal for which quantitative estimates are based largely on broad knowledge of the geologic character of the bed, or region, and for which there are few, if any measurements. The estimates are based on an assumed continuity, for which there is geologic evidence. In general, Inferred coal lies outside the limits defined for Measured and Indicated coal. Where there are only outcrop data on which to base estimates, Inferred coal is coal lying within areas established as described in paragraph 7, below, and more than 2 miles in from the outcrop.

6. Thickness of beds.--In all reports of coal reserves, sub-totals shall be prepared to show the reserves contained in beds falling within the following thickness ranges:

A. For anthracite, semi-anthracite, and bituminous coal
   a. More than 42 inches
   b. 28 to 42 inches
   c. 14 to 28 inches

B. For subbituminous coal and lignite
   a. More than 10 feet
   b. 5 to 10 feet
   c. 2½ to 5 feet
   d. 1½ to 2½ feet (Optional, but not to be used in summary totals)

According to this classification the minimum thickness for anthracite, semi-anthracite, and bituminous coal shall be 14 inches, and for subbituminous coal and lignite shall be 30 inches. Reserves in thinner beds may be reported for any area where the mining of such beds is in progress, or is believed to be feasible, but the reserves in these thin beds shall not be included in summary totals for larger areas without specific note of their inclusion.

The use of isopach lines is the most effective way to evaluate the thickness of a coal bed. Generally, however, the data are insufficient for this purpose and average figures must be used. When this is done the averages must be weighted according to the approximate area of bed represented by each observation. If the points of observation are not evenly spaced, the weighting can be accomplished most easily by assigning intermediate values for the thickness at places where data are needed to fill out a system of evenly spaced points. If this procedure is followed to obtain the weighted average thickness along the outcrop

of a persistent bed, the two end points of minimum thickness must also be included in the average. Where the points of observation are fairly evenly spaced, as in an exploratory or development drilling program, a simple average is sufficient. Partings of more than 3/8 inches thickness shall be omitted in determining the thickness of individual beds. Beds and parts of beds made up of alternating thin layers of coal and parting shall be omitted if the partings make up more than one-half the total thickness, or if the ash content exceeds 33 percent. Benches of coal of less than the minimum thickness stated above, which lie above or below thick partings and which normally would be left in mining, shall also be omitted.

The calculated average thickness should be recorded in a uniform manner either to the nearest whole inch or in feet and tenths to facilitate calculation. It is inadvisable to record fractions of an inch. The "Modulus of Irregularity" should not be employed to determine the average thickness of beds.

7. Areal extent of beds.--The total area of coal of all classes in each bed may be determined in several ways: Where the continuity of the bed is well established by maps of the outcrop, mine workings, drill holes, etc., as in the Pittsburgh bed, the entire area of known occurrence may be taken, even though points of observation are widely spaced. Persistent beds that have been traced around a basin or spur may be considered to underlie the area enclosed by the outcrop. Otherwise, the length of outcrop within the thickness limits listed above, is considered to establish the presence of coal of all classes in a semi-circular area having a radius equal to one-half the length of the outcrop. The total area of coal may be considered to extend beyond such a semi-circle if mine working or drill holes so indicate; in which case coal may be considered to extend only 1 mile beyond the limits of the mine workings. An isolated drill hole too far removed to be incorporated in the area thus defined, may be considered to determine an area of coal of all classes extending for a radius of ½ mile around the hole.

8. Bed maps.--For each individual bed, or under certain conditions, each group of beds, a map shall be prepared showing the outcrop of the bed, the thickness of coal at each measured section, the areas included in estimates of Measured, Indicated, and Inferred reserves, and the areas included in each thickness category, and the 1,000, 2,000, and 3,000 overburden lines. If information permits, mined-out areas should be plotted on the bed maps and calculations made for reserves originally present in the mined-out areas as well as for original and remaining reserves.

In the tables and text, reserves shall be reported for each bed, and all assumptions about the average thickness and extent shall be given, so that the work can be checked for arithmetical accuracy, and so that adjustments can be made in the future as more definite information is acquired.

9. Original reserves.--Original reserves are reserves in the ground before the beginning of mining operations. It is highly desirable that figures for original reserves be determined and presented as part of all reserve studies. These figures may be determined directly, or may be built up by adding figures for remaining reserves as of the date of the estimate to figures for the amount of coal mined and lost in mining as of the same date. (See paragraphs 10 and 11.)

10. Coal mined and lost in mining.--The amount of coal mined and lost in mining is continuously changing and any figure giving such information must be dated. The amount of coal mined and lost in mining may be determined in either of two ways:

A. By actual quantitative measurements of areas in which coal has been mined and where the mine-out areas are known. This method is the most desirable, and if properly done will upon comparison with coal production figures, yield percentage of recovery data that will have further usefulness.

B. The amount of coal mined in many areas can be obtained from production statistics, and if increased by a percentage factor to allow for coal lost in mining, will give a minimum figure for coal mined and lost in mining that is usable, though it is not as useful as the first method above.

11. Remaining reserves.--"Original reserves" minus "Coal mined and lost in mining" is "Remaining reserves." This also is a continuously changing figure, and must be dated. It includes total coal in the ground in unmined areas as of the date of the estimate.

12. Recoverable reserves.--"Recoverable reserves" are determined by applying a factor representing the percentage recovery of coal in mining according to the experience of operators working in the same area. The average amount of coal recovered in mining bituminous coal in the United States is about 50 percent of the amount of coal originally in the ground, and this factor must be used if no better data are available. Like "Coal mined and lost in mining" and "Remaining reserves," "Recoverable reserves" must be dated.

13. Date of Reserve estimates.--It is suggested that all statements of reserves other than "Original reserves" be prepared and reported as of January 1 of the year in which the work is done.

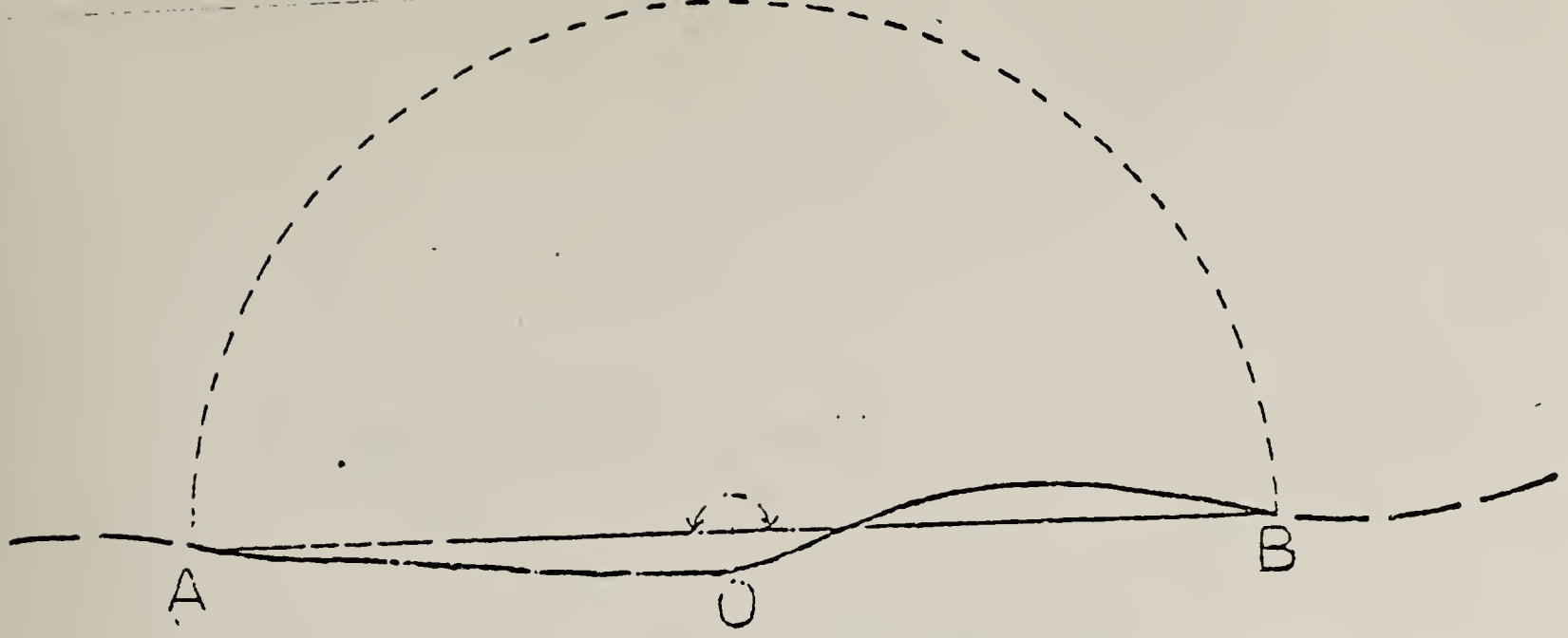


Figure 1. OUTCROP LACKING SIGNIFICANT RIDGES OR REENTRANTS - THE SIMPLEST POSSIBLE CASE

Accepted limit comprises an arc through A and B with radius $\frac{AB}{2}$ (= AO, where O is the mid-point on line AB).

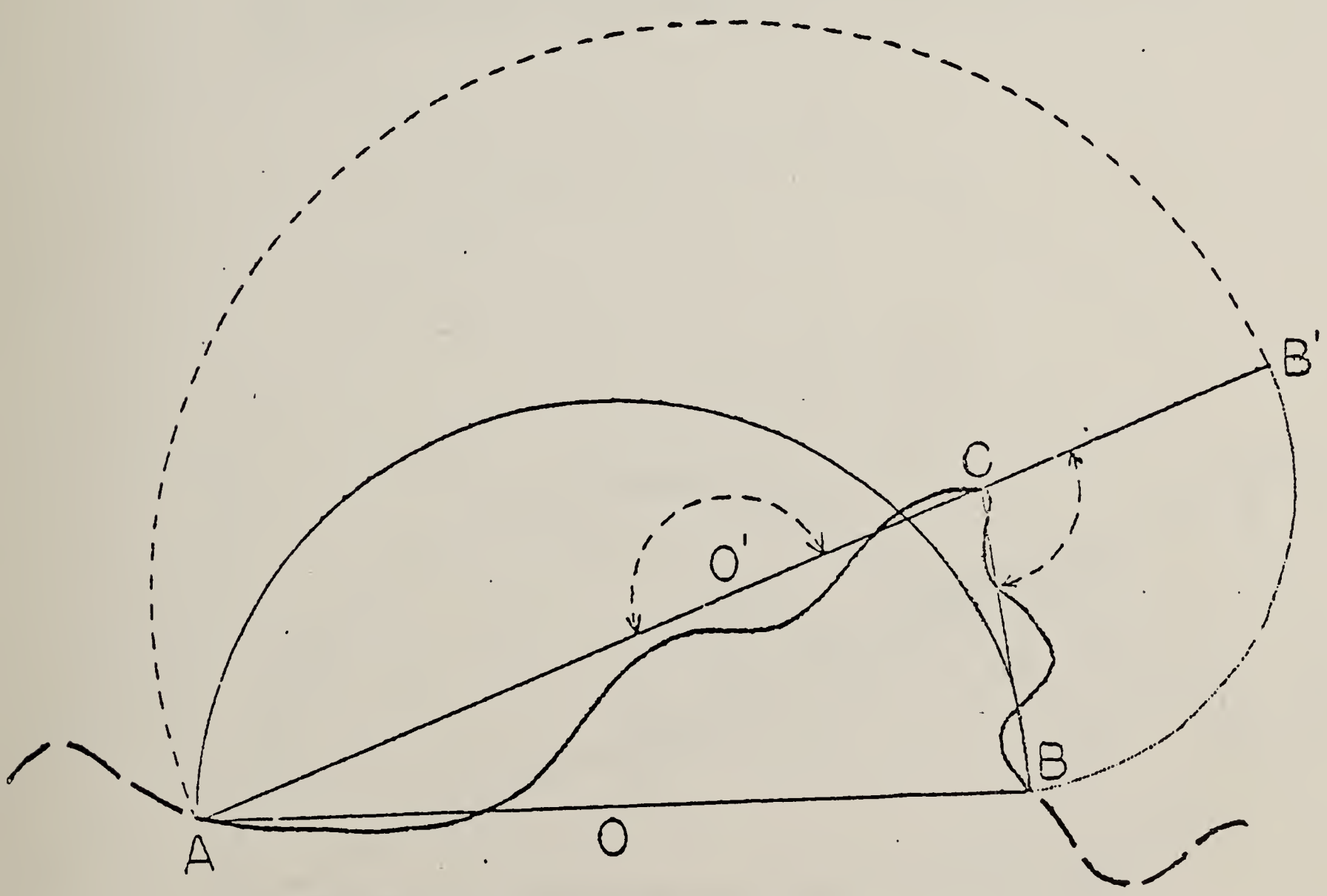


Figure 2. VALLEY REENTRANT (SIMPLE CASE)

Accepted limit comprises (a) an arc BB' with center at C drawn from B to the extention at B' of line AC and (b) arc B'A with center at the mid-point O' of the line AB'.

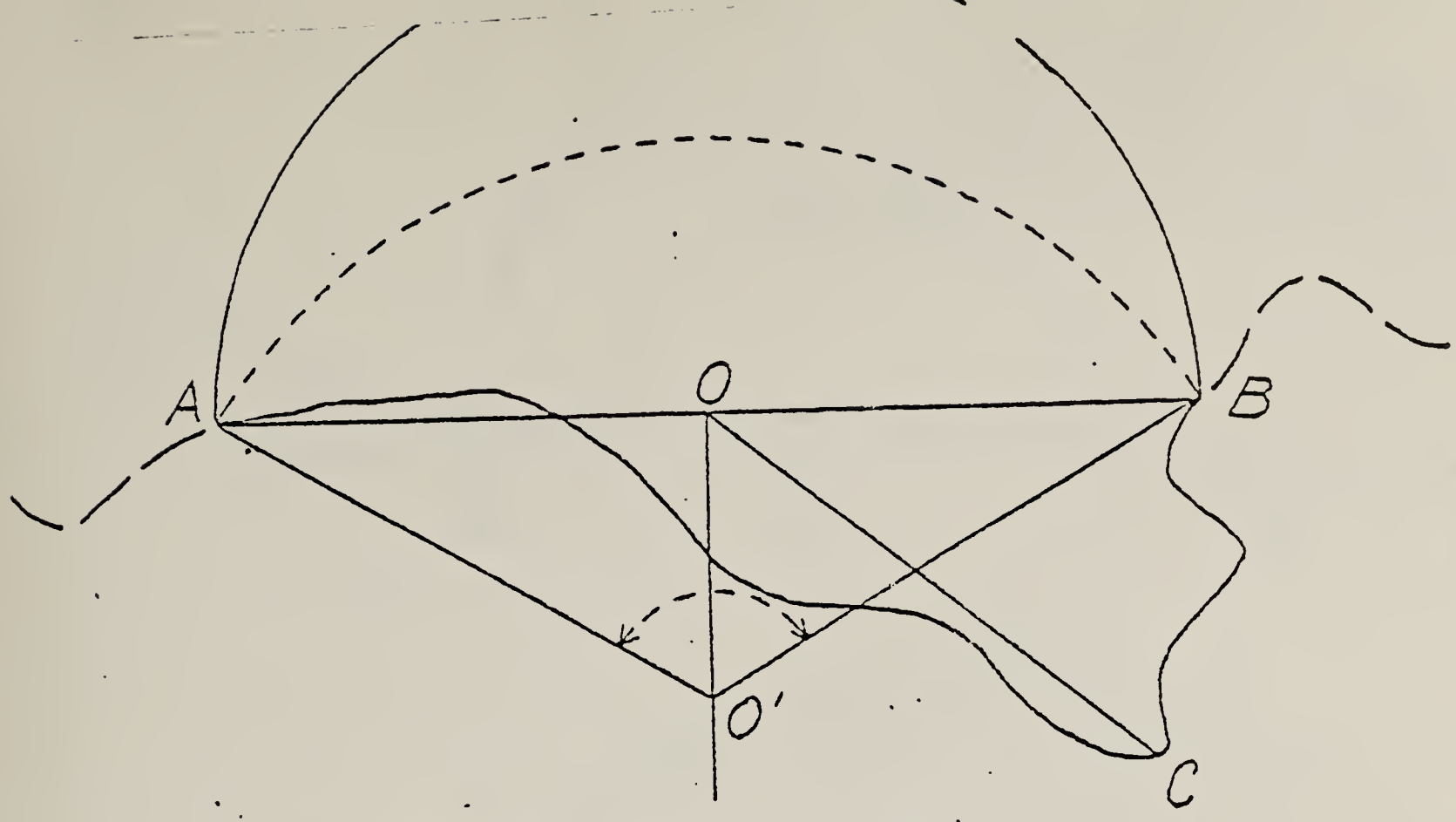


Figure 3. RIDGE (SIMPLE CASE)

Accepted limit comprises an arc AB with radius equal to the distance from the mid-point O of the line AB to the point C.

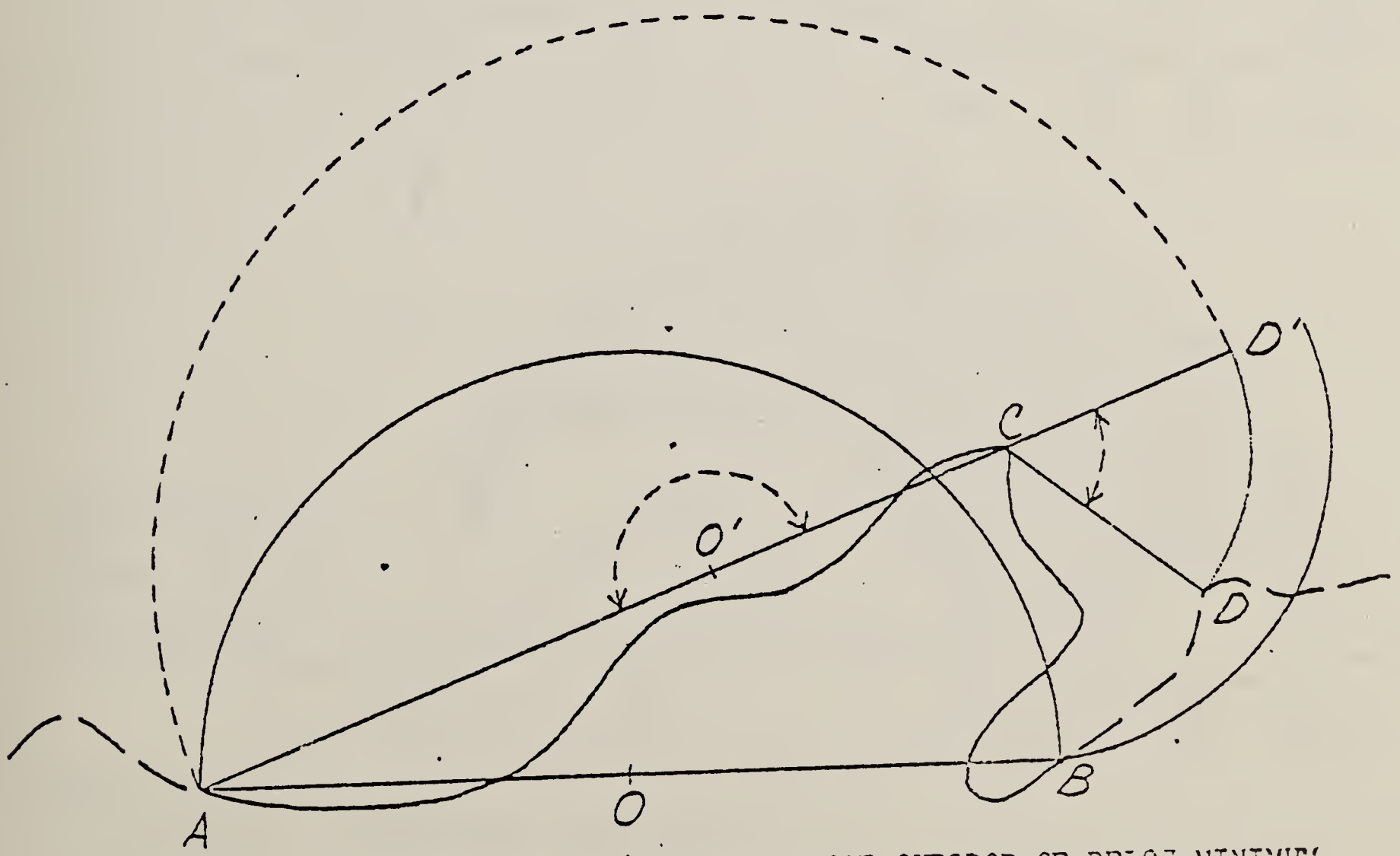
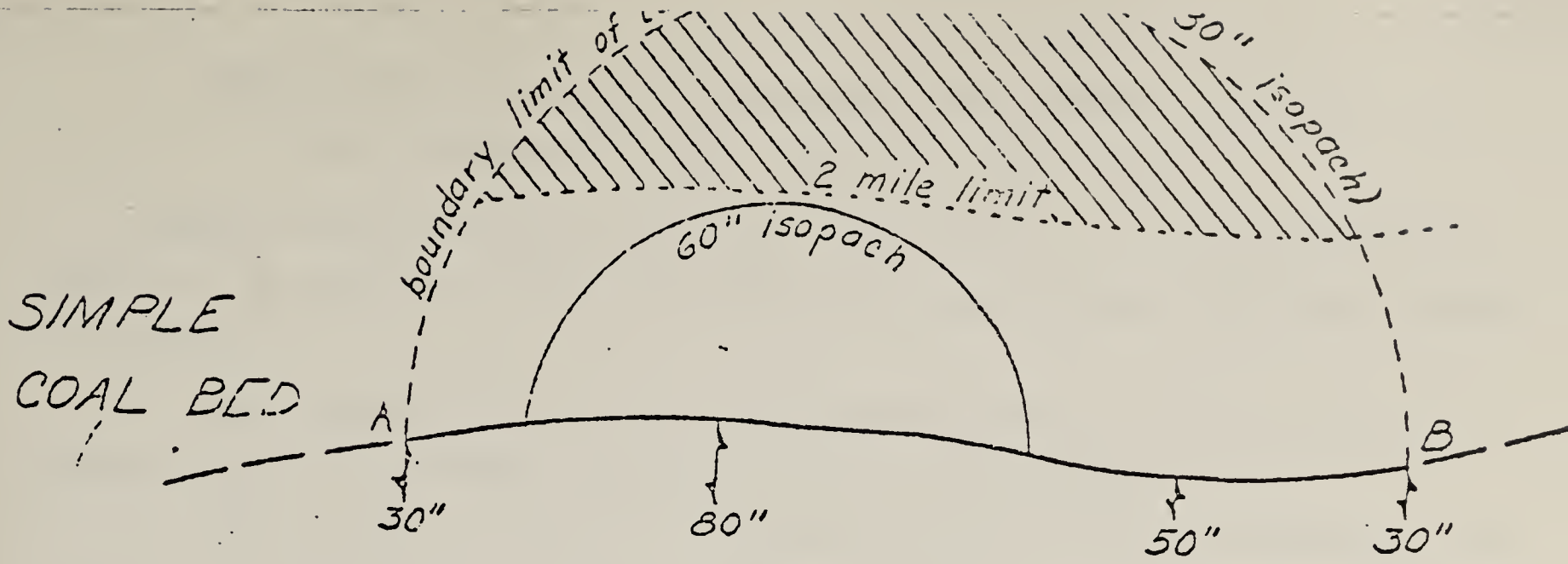
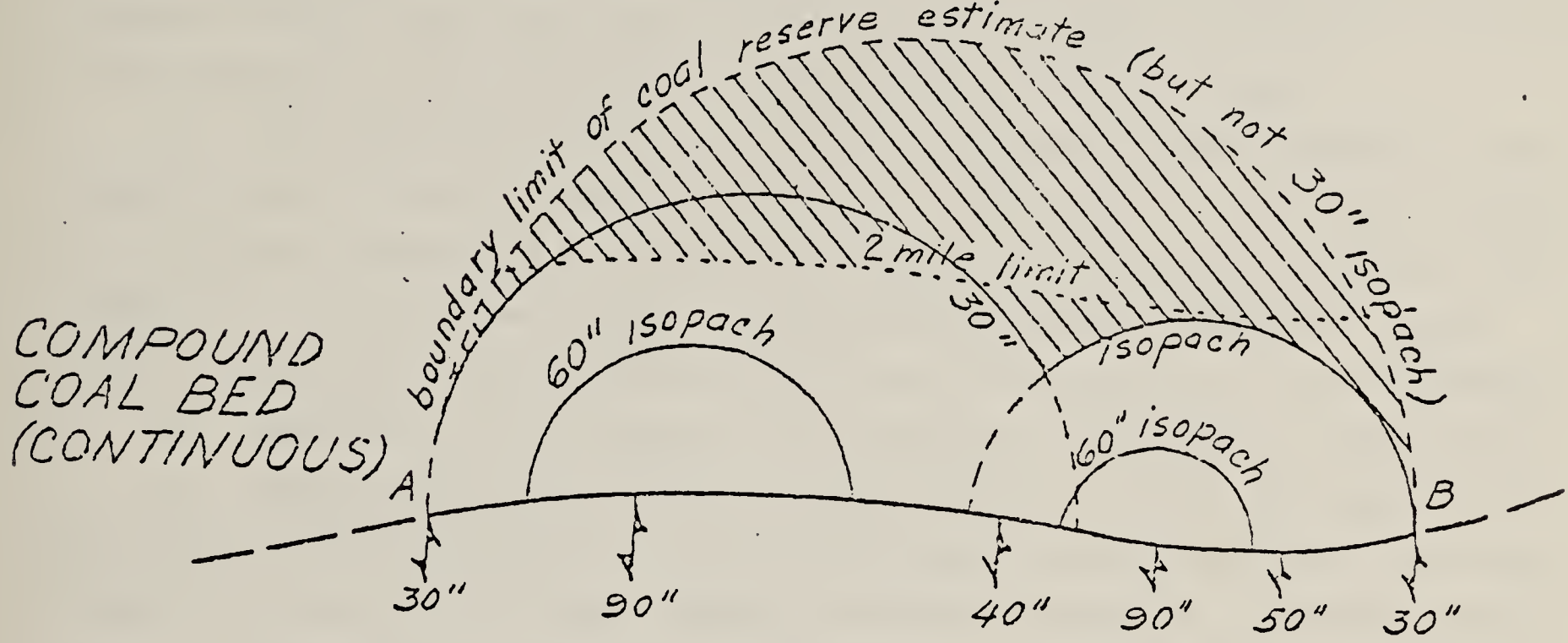
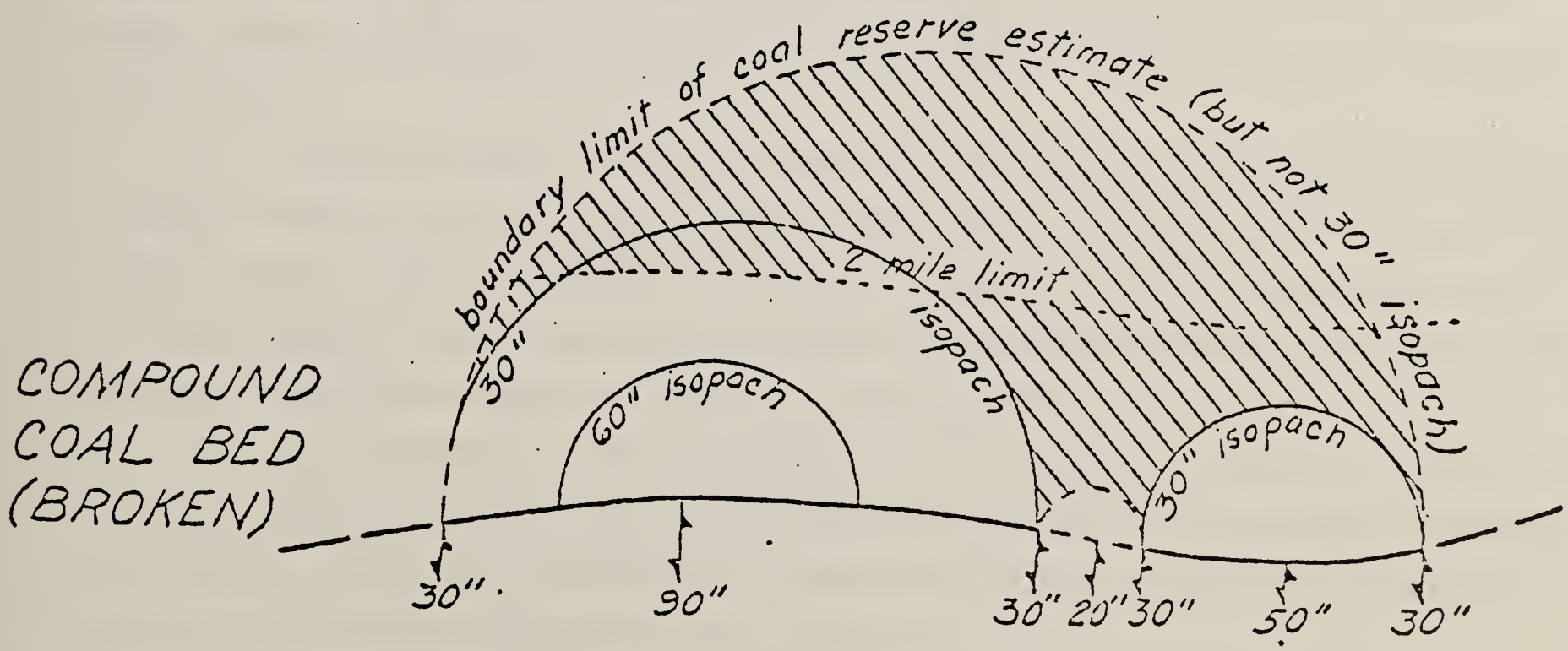


Figure 4. VALLEY REENTRANT (MODIFIED WHERE OUTCROP OF BELOW-MINIMUM THICKNESS LIES WITHIN THE ACCEPTED LIMIT AS DEFINED FOR THE SIMPLE CASE)

Accepted limit comprises (a) the outcrop line from B to the point at D nearest C, (b) the arc DD' with center at C drawn from D to the extension at D' of line AC, and (c) arc D'A with center at the mid-point







Inferred reserves

Indicated and measured reserves

Figure 5. Diagrams showing the techniques of provisional isopaching and defining positions of bodies of measured, indicated, and inferred coal reserves

GUIDELINES ON COLLECTING COAL SAMPLES FOR CHEMICAL ANALYSIS

U.S. Geological Survey, Branch of Coal Resources

Specific instructions on the exact type, number, and distribution of samples to be collected cannot be given, but some general guidelines should be followed:

1. The judgment of the geologist must be applied toward obtaining samples which will be most representative of the coal bed.

2. Only samples of fresh or unweathered coal should be submitted for analysis, preferably from a newly exposed mine face. The samples should be shipped within a few days after collection to minimize the effect of oxidation and exposure to air on the moisture content and forms of sulfur.

3. The objective should be to obtain a complete channel sample of the minable bed; if the coal bed is more than 5 feet thick, a good rule-of-thumb is to collect one sample of each 5-foot interval of coal (for example, four samples of a bed 20 feet thick). Special-type samples (prominent fusain band, for example) will also be analyzed, at the discretion of the geologist.

4. Generally, 4 to 5 pounds of coal should be included in each sample.

5. Plastic bags (10" x 15" or larger) should be used, and care should be taken to avoid contact of the coal with metal during and after collecting sample (the use of a geologic hammer, of course, cannot be avoided); sample number, date of collection, and key description should be written with a magic marker (permanent ink) on each bag, and on a label attached to the tie on the bag.

6. A rule-of-thumb should be never to collect a single sample from one locality--always collect two, or if a mine face is several hundred yards long, collect three channel samples; the main reasons for this collecting of two or three samples are that short-distance composition changes can be assessed, and that possible analytical errors can be spotted.

7. Core samples of coal are better than samples of weathered coal, but contamination by drilling fluids generally makes trace-element analyses unreliable. Name and composition of drilling fluids used should accompany list of core samples submitted for analysis.

8. Shale splits, siltstone partings, or bone coal less than a few inches (5-10 cm) generally should be included in a channel sample if it is probable that this material will be included in mined coal; special samples of these materials should also be collected, based on the judgment of the geologist, to determine their contribution to abnormal element concentrations.

9 If project objectives include the obtaining of knowlege of coal shipped or of plant feed, extra care should be taken to collect at least two representative raw coal, cleaned coal, blend-pile, and conveyor-belt samples; such sample sets should include, where possible, representative samples of furnace-bottom ash, and fly ash from precipitator/scrubber units.

10. Where geochemical data on seatrock/underclay and overburden rock are desired, representative samples should be collected following the above guidelines. In collecting overburden samples, one of two methods may be preferable, depending on local conditions: a) channel samples of 5- or 10-foot intervals: or b) two samples of each lithology, which can then be tied to measured sections and assigned weighted values.

11. If permission to sample is obtained from a company, the offer should be made, and promise kept, to provide a copy of the analytical results as soon as they are completed to the company; where possible, obtain available analytical data from the company for comparison with your analyses. It should be made clear to the company or landowner that the analyses of your samples will be part of the public record; the collection of samples which requires a promise to withhold analyses on a "company confidential" basis should be done only for compelling scientific reasons.

SUBMITTING SAMPLES

After the samples have been collected and are ready to be shipped, a simple list of sample-description information should be prepared. The samples should be listed by number, each sample number followed by the name and thickness of the coal bed, the name and age of the formation and member which include the coal bed, the precise location of the sampled locality, the date the sample was collected, and who collected it. For example:

Sample no.	Sample description
HC-21-72	Channel sample of Waynesburg coal bed, 3.6 ft thick, lower member of Waynesburg Fm., Upper Pennsylvanian(?) 40°13'20", 80°11'10" [or, 1.2 mi. E-NE of McGovern], Washington Co., Pa.; coll. by John Smith Oct. 16, 1972

A copy of this list should be sent with the samples and, to assure this information arrives, another copy should also be sent by mail in another envelope. The samples and the list of sample information should be sent to:

Vernon E. Swanson
U.S. Geological Survey
Building 25, Federal Center
Lakewood, Colorado 80225

The samples should be sent by the commercial carrier most conveniently available to the geologist. In most places, packing the samples in small cartons and sending by mail is the easiest procedure. Because the coal and, especially, rock samples can cut through its plastic bag while being jostled during mail handling, care should be taken to cushion the sample bags in the cartons with wadded newspapers.

ANALYSIS SEQUENCE

When the samples are received at the Federal Center in Colorado, they will be submitted by prior arrangement to Analytical Laboratories Branch. The samples will be crushed, air-dried to constant weight, and split according to amounts needed by the several laboratories; a split will also be retained for follow-up work and permanent storage.

An undried sample split of about 1 qt for samples representative of the set collected will be sent to the U.S. Bureau of Mines at Pittsburgh, Pa., for the routine coal analysis that has been provided to the Geological Survey for many decades. This analysis sequence includes: (1) proximate analysis (percent ash, moisture, fixed carbon, and volatile matter); (2) ultimate analysis (percent carbon, hydrogen, oxygen, nitrogen, and sulfur); (3) Btu determination; and (4) sulfur analysis (percent organic sulfur, pyrite sulfur, sulfate sulfur, and total sulfur).

The Geological Survey laboratories will routinely provide the following analytical determinations on all samples:

1. Major composition of the ash of coal--percent ash, SiO_2, Al_2O_3, Na_2O, K_2O, CaO, MgO, Fe_2O_3, P_2O_5, Cl, MnO, TiO_2, and SO_3.
2. Trace-element composition of coal.
   a. Individual quantitative determinations--ppm As, Cd, Cu, F, Hg, Li, Pb, Sb, Se, Th, U, and Zn.
   b. Semiquantitative spectrographic analysis--ppm of 20-30 elements detected by this method.

c. Individual quantitative determinations, of abnormal amounts indicated by semiquantitative analysis, or on spot-check basis--ppm Ag, Au, Be, Bi, Ge, Mo, Ni, Te, Tl, and V.

Copies of all analyses of coal samples will be sent to the geologist who collected the samples; if extra copies are desired by the geologist to give to, for example, owners of property from which samples were collected, so indicate on the sample list accompanying the sample. A copy of the analyses will also be retained by Swanson's office.

All analyses are reported either as percent or parts per million (ppm). Further, all analytical data, when included in a written report, should be reported as percent or parts per million:

1. Proximate and ultimate analyses, in percent on an as-received, air-dried, moisture-free, and moisture- and ash-free basis.
2. Major composition of ash, in percent of ash.
3. Trace-element composition, in parts per million of "whole coal" on an air-dried basis.
4. Btu values are, of course, not shown in percent or parts per million, simply as "Btu, 13,360"; semiquantitative analyses will be reported as percent or parts per million of ash.

The attached flowsheet indicates the chemical methods used in the analytical sequence. Detailed description of these methods can be obtained from Claude Huffman, Jr., U.S. Geological Survey, Bldg. 25, Federal Center, Denver, Colorado 80225.

USGS-BR. of MINERAL CLASSIFICATION
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MENLO PARK, CALIF.

CRITERIA FOR CLASSIFICATION OF COAL LANDS

Land shall be classified as coal land under the following criteria:

Thickness The minimum thickness for coals of more than lignite rank is 14 inches; for lignite, 30 inches. Coals thicker than 6 feet are treated as 6-foot beds. Partings of bone or impure coal are deducted from the thickness of the bed.

Quality (heat value) A minimum of 4,000 Btu per pound of an as-received, unwashed or washed, unweathered sample is required.

Depth For the minimum grade and thickness the maximum classifiable depth is 1,000 feet; this increases with increasing grade and thickness to a maximum depth of 6,000 feet.

Quantity Any legal subdivision underlain by at least 2,000 tons of coal of classifiable quality and thickness.

Explanation

Depth below the surface varies with thickness and quality:

(a) The depth increase below 1,000 feet for a bed of coal 6 feet or more thick having heat values between 4,000 and 9,000 Btu's is 400 feet for each 1,000 Btu; and between 9,000 and 15,000 Btu, there is an increas. of 333 feet for each 1,000 Btu.

(b) A coal of maximum quality (15,000 Btu) and minimum thickness (14 inches) is classifiable to 1,000 feet, increasing to 6,000 feet as thickness increases: 1,500 feet for 20 inches thickness; 2,000 feet for about 26 inches; 3,000 feet for about 37 inches; 4,000 feet for about 4 feet 1 inch; 5,000 feet for about 5 feet 6 inches; and 6,000 feet for about 6 feet of thickness or more.

(c) If the topography is such that part or all of the coal lies below the depth limit, but can be mined by means of an adit or tunnel, the land shall also be classified coal lands.

(d) The depth limit shall be computed for each individual bed except that where two or more beds occur in such relation that they may be mined together. Under such conditions the depth limit may be determined on the beds as a unit considering the partings or other impurities between successive beds.

Classification is made on the basis of legal subdivisions; quarter-quarter sections, surveyed tracts, or lots.

Table 4.—Major, minor and trace element composition of seven coal samples from Lawrence County, Ky., reported on whole-coal basis. (Values are in either percent or parts per million. Al, Ca, Fe, Mg, Na, K, Si, Cl, Mn, P, Ti, Cd, Cu, Li, Pb, and Zn values were calculated from analyses of ash. As, F, Hg, Sb, Se, Th and U values are from direct determinations on air dried (32°C.) coal. The remaining analyses were calculated from spectrographic determinations on ash. L after a value means less than the value shown, N means not detected, and B means not determined.)

SAMPLE	AL %	CA %	FE %	MG %	NA %	K %	SI %	CL %	MN PPM	P PPM
D168259	0.31	0.036	1.1	0.024	0.005	0.029	0.49	0.01L	12.	10.L
D168260	0.24	0.070	3.0	0.012	0.008	0.019	0.62	0.01L	30.	10.L
D168261	0.14	0.090	3.8	0.020	0.009	0.014	0.51	0.01L	30.	10.L
D168262	2.1	0.082	3.0	0.032	0.015	0.12	2.7	0.01L	26.	40.
D168263	0.70	0.071	2.5	0.025	0.012	0.043	1.5	0.01L	21.	10.L
D168264	1.2	0.048	2.5	0.021	0.007	0.062	1.4	0.01L	21.	297.
D168265	1.3	0.12	1.6	0.020	0.006	0.040	1.3	0.01L	15.	

SAMPLE	TI %	AS PPM	CD PPM	CU PPM	F PPM	HG PPM	LI PPM	PB PPM	SB PPM	SE PPM
D168259	0.017	35.	0.1L	13.0	20.L	0.39	2.5	13.8	3.0	2.0
D168260	0.009	50.	0.1L	15.2	40.	0.20	1.9	12.2	2.2	5.0
D168261	0.012	40.	0.1L	16.7	40.	0.22	2.2	7.9	1.9	5.3
D168262	0.046	140.	0.3	22.0	20.L	1.5	30.9	72.2	10.8	IN.
D168263	0.033	35.	0.1L	17.6	20.	0.23	9.7	9.0	1.9	6.0
D168264	0.022	70.	0.1L	15.9	70.	0.35	18.0	23.9	2.4	3.3
D168265	0.019	45.	0.1L	9.0	120.	0.45	15.7	11.1	2.8	8.5

SAMPLE	TH PPM	U PPM	ZN PPM	B PPM	BA PPM	BE PPM	CO PPM	CR PPM	CS PPM	LA PPM
D168259	0.08	1.3	39.8	70	10	7	10	7	20	N
D168260	0.08	1.3	17.0	70	70	3	2	2	10	N
D168261	2.7	1.1	17.4	100	100	5	2	2	10	N
D168262	14.	13.	76.6	50	30	3	10	20	30	N
D168263	0.08	0.7	34.0	100	50	5	10	5	7	7
D168264	3.9	2.7	33.3	70	10	2	3	7	7	N
D168265	4.7	1.6	21.2	70	70	1	7	15	15	15

SAMPLE	MO PPM	NB PPM	NI PPM	SC PPM	SR PPM	V PPM	Y PPM	YB PPM	ZR PPM
D168259	3	N	50	7	20	10	5	0.7	5
D168260	3	N	10	1	15	7	3	B	B
D168261	7	N	7	1.5	20	15	7	B	2
D168262	10	N	20	7	20	30	15	B	20
D168263	5	N	15	3	50	15	10	B	10
D168264	3	N	15	3	15	20	7	B	B
D168265	7	N	10	5	130	20	7	B	B

Table 3.—Content of seven trace elements in seven coal samples from Lawrence County, Ky. (Analyses on air-dried (32°C.) coal. All values are in parts per million. L after a value means less than the value shown, B means not determined.)

SAMPLE	AS	F	HG	SB	SE	TH	U
D168259	35.	20.L	0.39	3.0	2.9	B	1.3
D168260	50.	40.	0.20	2.2	5.0	B	1.2
D168261	40.	40.	0.22	1.9	5.3	2.7	1.1
D168262	140.	20.L	1.5	10.8	18.	14.	15.
D168263	35.	20.	0.23	1.9	6.0	B	0.7
D168264	70.	70.	0.36	2.4	3.3	3.9	2.7
D168265	45.	120.	0.45	2.8	8.5	4.7	1.6

Table 2.—Major and minor oxide and trace element composition of laboratory ash of seven coal samples from Lawrence County, Ky.
(Values are in either percent or parts per million. The coals were ashed at 525°C. L after a value means less than the value shown, N means not detected, and B means not determined. S after the element title means that the values listed were determined by semiquantitative spectrographic analysis. The spectrographic results are to be identified with geometric brackets whose boundaries are 1.2, 0.83, 0.56, 0.38, 0.26, 0.18, 0.12, etc., but are reported arbitrarily as mid-points of those brackets, 1.0, 0.7, 0.5, 0.3, 0.2, 0.15, 0.1, etc. The precision of the spectrographic data is approximately one bracket at 68 percent, or two brackets at 95 percent confidence.)

SAMPLE	ASH %	AL2O3 %	CAO %	FE2O3 %	MGO %	NA2O %	K2O %	SO3 %	SIO2 %	CL %
D168259	3.62	16.	2.2	42.	1.1	0.19	0.95	2.8	29.	0.10L
D168260	6.98	6.6	1.4	62.	0.28	0.15	0.34	1.7	19.	0.10L
D168261	8.36	7.6	1.5	65.	0.40	0.15	0.63	2.3	13.	0.10L
D168262	15.2	29.	0.58	29.	0.35	0.13	0.92	0.59	38.	0.10L
D168263	8.86	15.	1.1	41.	0.46	0.13	1.1	1.4	36.	0.10L
D168264	9.36	25.	0.72	39.	0.37	0.09	0.79	0.83	31.	0.10L
D168265	8.18	29.	2.0	27.	0.40	0.09	0.59	1.3	35.	0.10L

SAMPLE	MNO %	P2O5 %	TIO2 %	CD PPM	CU PPM	LI PPM	PH PPM	ZN PPM	B PPM-S	BA PPM-S
D168259	0.043	0.10L	0.78	1.L	360.	70.	380.	1100.	2000	300
D168260	0.055	0.10L	0.19	1.L	218.	26.	175.	244.	1000	1000
D168261	0.076	0.10L	0.24	1.L	200.	26.	195.	208.	1000	1000
D168262	0.022	0.10L	0.94	2.	150.	256.	475.	504.	300	200.
D168263	0.031	0.10	0.62	1.L	196.	110.	90.	384.	1000	500.
D168264	0.028	0.10L	0.39	1.L	170.	192.	255.	336.	700	100
D168265	0.023	0.30	0.39	1.L	110.	192.	160.	260.	700	700

SAMPLE	BE PPM-S	CO PPM-S	GA PPM-S	GE PPM-S	LA PPM-S	MO PPM-S	NB PPM-S	NI PPM-S	SC PPM-S	SR PPM-S
D168259	200.	300.	200	500	N	100	N	1500	200	700
D168260	30.	30	30.	150	N	30	N	150	15	200
D168261	50	20	30	100	N	70	N	100	20	300
D168262	20.	70	150.	200	N	70	N	150	50	150
D168263	50	100	50	70.	70.	50	10.L	150	30	500
D168264	20	30	70	70	N	50	N	150	30	150.
D168265	15	70	150	200	150.	70	N	150	50	2000.

SAMPLE	V PPM-S	Y PPM-S	YB PPM-S	ZR PPM-S
D168259	300	150	20.	150
D168260	100.	50	B	N
D168261	150	70.	B	30
D168262	200	100	B	150
D168263	150	100	B	100
D168264	200	70	B	70
D168265	300	70	B	70

Table 1.--P' 'mate, ultimate, Btu and forms of sulfur analyses of five s les from Lawrence County, Ky. Each sample represents the .re thick of the b.. (All analyses except Btu are in percent. Original moisture content may be slightly more than shown because samples were collecte and transported in plastic bags to avoid metal contamination. Form of analyses: A, as received; B, moisture free; C, moisture and ash free. All analyses by Coal Analysis Section, U.S. Bureau of Mines, Pittsburgh, Pa.)

SAMPLE NO.	FORM OF ANALYSIS	PROXIMATE ANALYSIS				ULTIMATE ANALYSIS					BTU VALUE	FORMS OF SULFU		
		Moisture	Volatile matter	Fixed carbon	Ash	Hydrogen	Carbon	Nitrogen	Oxygen	Sulfur		Sulfate	Pyritic	O
D168260	A	4.7	41.6	47.3	6.4	5.5	70.6	1.4	11.8	4.3	12820	0.00	3.46	
	B	—	43.6	49.7	6.7	5.2	74.1	1.5	7.9	4.6	13450	0.00	3.64	
	C	—	46.8	53.2	—	5.5	79.4	1.6	8.6	4.9	14420	0.00	3.90	
D168261	A	4.6	39.1	48.8	7.5	5.3	70.0	1.4	12.2	3.6	12660	0.11	2.95	(
	B	—	41.0	51.1	7.9	5.0	73.4	1.5	8.4	3.8	13270	0.11	3.09	(
	C	—	44.5	55.5	—	5.5	79.7	1.6	9.1	4.1	14400	0.12	3.36	(
D168263	A	6.6	36.2	48.3	8.9	5.2	67.1	1.4	14.1	3.3	12030	0.11	2.60	(
	B	—	38.8	51.7	9.5	4.8	71.9	1.5	8.8	3.5	12880	0.12	2.79	(
	C	—	42.9	57.1	—	5.3	79.5	1.7	9.6	3.9	14240	0.13	3.08	(
D168264	A	7.2	36.0	48.4	8.4	5.3	67.0	1.4	14.7	3.2	12060	0.13	2.53	(
	B	—	38.8	52.1	9.1	4.9	72.2	1.5	8.8	3.5	12990	0.14	2.73	(
	C	—	42.7	57.3	—	5.4	79.4	1.6	9.8	3.8	14290	0.15	3.00	(
D168265	A	7.2	36.0	49.6	7.2	5.5	68.7	1.4	15.2	2.0	12240	0.08	1.42	(
	B	—	38.8	53.4	7.8	5.1	74.0	1.5	9.5	2.1	13200	0.09	1.53	(
	C	—	42.1	57.9	—	5.5	80.3	1.7	10.2	2.3	14310	0.09	1.66	(

CONTENTS

Table 1. Standard coal analyses by U.S. Bureau of Mines.

Table 2. Major and minor oxide and trace element composition of the laboratory ash.

Table 3. Content of seven trace elements in seven coal samples.

Table 4. Major, minor and trace element composition of seven coal samples.

CHEMICAL ANALYSES OF SEVEN COAL SAMPLES

FROM LAWRENCE COUNTY, KENTUCKY

by

U.S. Geological Survey
Denver, Colorado 80225
February 14, 1975

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Charles L. Pillmore, Geologist, Branch of Coal Resources,
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V. M. Merritt, H. T. Millard, D. R. Norton, G. D. Shipley,
J. A. Thomas, R. E. Van Loenen, J. S. Wahlberg, and R. A. Zielinsk

USGS, Analytical Laboratories
Branch, Denver

Raw coal as received (about 5 pounds, or 11 kg, broken to <3 cm)

One quart (about 600 g) of coal split out for U.S. Bureau of Mines analysis

Air dry in oven at 32° C

Ultimate and proximate analyses (procedures described in U.S. Bur. Mines Bull. 637, 1967, p. 3-12)

Sample crushed and then ground in vertical Braun pulverizer using ceramic plates set to pass 80 mesh, and mixed

One-pint crushed coal split out for storage

Raw ground coal

Ultimate analysis and sulfurs
% Ash
C
H
O
N
S (total)
S (sulfate)
S (pyritic)
S (organic)

Proximate analysis
% Moisture, volatile matter, fixed carbon, and ash

Ground coal (25 to 75 g) ashed at 525°C and % ash calculated, ash then mixed

Wet chem. analysis
Hg (flameless AA)
Sb (colorimetric)
As (colorimetric)
F (selective ion electrode)

X-ray fluor.
Se

Neutron activation
U
Th

Coal ash

Heat value
Btu (per pound)

Wet chemical analysis (A.A.)
Mg
Na
Cd
Cu
Li
Pb
Zn

Six-step spect. analysis (60 element looked for) Elements generally reported:	
B	Nb
Ba	Ni
Be	Sc
Co	Sr
Cr	V
Ga	Y
Ge	Yb
La	Zr
Mo	

X-ray fluorescence analysis
Al
Ca
Fe
K
P
Si
S
Ti
Mn
Cl

Standards for the Classification of Public Coal Lands

By N. Wood Bass, Henry L. Smith, and George H. Horn

GEOLOGICAL SURVEY CIRCULAR 633

A revision of the rules used in the classification of coal lands on the public domain



Washington 1970

CONTENTS

	Page
Abstract	1
Introduction	1
History	1
Purpose of classification	2
Present standards	3
Maximum depth	5
Maximum depth for coals of minimum thickness	5
Use of as-received Btu values	5
Minimum heat value	5
Minimum thickness	5
Maximum thickness	6
Thickness of coal beds containing partings	6
Present standards—Continued	
Treatment of coal beds of irregular thickness	6
Treatment of a thin coal associated with a thick coal and treatment of a group of coal beds	7
Burned coal	8
Quality	8
Diagram (fig. 1) showing depth limits of coals	8
Areal basis for classification	9
Summary of the standards for the classification of public coal lands	9
References cited	10

ILLUSTRATIONS

	Page
FIGURE 1. Diagram showing depth limits of coals of different Btu (as-received basis) and of different thicknesses less than 6 feet	4
2. Diagram showing split or broken beds and their value for classification	7

Standards for the Classification of Public Coal Lands

By N. Wood Bass, Henry L. Smith, and George H. Horn

ABSTRACT

In order to provide uniformity in the classification of coal lands in the public domain, certain standards have been prepared from time to time by the U.S. Geological Survey. The controlling factors are the depth, quality, and thickness of the coal beds. The first regulations were issued April 8, 1907; others followed in 1908, 1909, and 1913. Except for minor changes in 1959, the regulations of 1913, which were described in U.S. Geological Survey Bulletin 537, have been the guiding principles for coal-land classification. Changes made herein from the standards previously used are: (1) a maximum depth of 6,000 feet instead of 5,000 feet, (2) a maximum depth of 1,000 feet instead of 500 feet for coals of minimum thickness, (3) use of Btu (British thermal unit) values for as-received coal instead of air-dried, and (4) a minimum Btu value of 4,000 for as-received coal instead of 8,000 for air-dried. An additional modification is that the maximum thickness of 8 feet which was designated in the Classification Chart for Coal Lands in 1959 is changed to 6 feet. The effect of these changes will be the classification of a greater amount of the withdrawn land as coal land than was done under earlier regulations.

INTRODUCTION

The purpose of this report is to set forth certain changes in the standards for determining what lands in the public domain are classifiable as coal lands. The controlling factors in determining what lands are coal lands are the depth, quality, and thickness of the coal beds. Changes made from the standards previously used (Smith and others, 1913) are: (1) a maximum depth of 6,000 feet instead of 5,000 feet, (2) a maximum depth of 1,000 feet instead of 500 feet for coals of minimum thickness, (3) use of Btu (British thermal unit) values for as-received coal instead of air-dried, and (4) a minimum Btu value of 4,000 on an as-received basis instead of 8,000 on an air-dried basis. An additional modification is that the maximum thickness of 8 feet which was used in a Classification Chart for Coal Lands (U.S. Geological Survey unpub. chart, approved by Acting Director, Sept. 9, 1959) is changed to 6 feet. The effect of these changes will be the classification of a greater amount of the withdrawn land as coal land than was done under earlier regulations. A minimum thickness of 14 inches for coals yielding 12,000 Btu or more, which has been in effect for almost 60 years, is not changed. The minimum thickness for coals of lesser Btu values is increased at specified rates.

Many geologists of the U.S. Geological Survey have contributed to the preparation of this report.

HISTORY[1]

Prior to May 20, 1862, when the Homestead Act was passed by Congress, lands of the public domain were sold by the Federal Government and thus constituted a source of national revenue. Upon passage of the Homestead Act, the national policy became the promotion of settlement and the development of the public domain. The mineral land laws, enacted by Congress mainly between 1865 and 1875, had as their purpose the promotion of mineral development on the public domain. These laws were based on local mining customs in force in the mining camps of that time. The act of May 10, 1872 provided for the exploration and purchase of mineral land on the public domain; it clearly was written to embrace metalliferous minerals, both lode and placer, for these were the miners' deposits known and sought at that time. From time to time in later years Congress authorized the acquisition under the placer laws of non-metalliferous minerals, which included petroleum, salines, and building stone.

Public lands containing coal were dealt with by separate acts of Congress. The act of March 3, 1873, provided for the purchase of coal land on the public domain at $10 an acre if the land

[1] Most of the history and many other parts of this report were obtained from Smith and others (1913).

was more than 15 miles from a railroad and at $20 an acre if the land was within 15 miles of a railroad. An individual was limited to 160 acres, an association of persons might acquire 320 acres, and an association of four or more persons who had opened and improved a coal mine at a cost of more than $5,000 could purchase an area of 640 acres.

Although it was not specifically stated, it is apparent from the language used in the many public land laws that the intent of Congress was to dispose of tracts in the public domain for whatever use they were best suited. For example, the Homestead Act stipulated "* * * nor shall any mineral lands be liable to entry and settlement.". As early as 1785 the Continental Congress stipulated that each State entering the Union would be granted a part of each township for schools. Ohio, the first State admitted to the Union (April 30, 1802), was allotted sec. 16 of each township. Later, other States were granted secs. 16 and 36, and a few States, secs. 2, 16, 32, and 36. The lands so granted were to be nonmineral, and wherever the stipulated sections were not available, the State was allowed to select other tracts in lieu of the allotted sections, but such tracts were to be nonmineral. Beginning on July 1, 1862, the railroad grants made by Congress to corporations to build railroads stipulated that the railroad corporations were to receive every alternate section of land in belts ranging in width from 20 to 40 miles on each side of the railroad; these sections were to include only nonmineral land, except for coal and iron land.

Congress stipulated in the act of March 3, 1879, which created the U.S. Geological Survey, that the Director of the Survey should classify the public lands. Except, however, for withdrawals of public lands for inclusion in reclamation projects and the segregation of reservoir sites, the classifications of land by the Geological Survey during the first 25 years of its existence were broadly based to identify features pertaining to land values for many purposes. President Roosevelt in 1906 directed the Secretary of the Interior to immediately withdraw from entry all valuable coal lands on the public domain. The Geological Survey, on the basis of its mass of scientific information on the public domain, prepared a list of public lands which had a reasonable probability of containing valuable coal, and these lands were promptly wi drawn from entry. Some additions were made the withdrawals during the next few years. was not until June 25, 1910 (30 Stat. 847), ho ever, that Congress passed the withdrawal a although the earlier withdrawals had been force since 1906. The Geological Survey, beg ning in 1906 upon instructions from the Sec tary of the Interior, was engaged in examini the withdrawn lands, and on the basis of th investigations the lands were classified; lands found to be noncoal were restored to try, those found to contain workable coal b were appraised and priced at varying amou per acre.

Inasmuch as the lands withdrawn inclu some lands that were valuable for farming, C gress later passed laws known as the "Sepa tion Acts"—the act of March 3, 1909 (35 St 644) and the act of June 22, 1910 (36 Stat. 58 —which provided for a separation of the surf rights and the mineral rights and allowed land claimant to obtain patent to his land reserving to the United States the coal depos and the right to prospect and mine them.

The Mineral Leasing Act of February 1920 (41 Stat. 407) provided for the leasing coal and other mineral lands on the public main and ended the practice of disposing of lands at appraised values. Under the provisi of the Mineral Leasing Act a permit to expl public land for coal may be obtained, or, if land is known to contain workable coal, it subject to competitive bidding for a lease. operator is required to pay the Federal Gove ment a stipulated royalty per ton of coal mi and an annual rental for the land held un lease.

During the four decades following the sage of the Leasing Act, the geologic exam tion and classification of withdrawn lands tinued at a reduced rate. In 1960, however, accelerated program of examination and cla fication of lands withdrawn for leasable m erals was begun.

PURPOSE OF CLASSIFICATION

In order to provide uniformity to execu action in the classification of coal lands in public domain, certain standards for determ ing what lands are coal lands have been pared from time to time by the Geological S

vey. It is the duty of the Geological Survey to determine what lands are underlain by coal within the limits set by these classification standards. Field examination to determine the presence of coal, thickness of beds, quality, attitude, depth, and other factors about the coal should precede classification. The field data should be assembled in such a form, including legible maps on adequate scale, as to facilitate the work of classification. Classification involves the consideration of all known geologic facts to determine what legal subdivisions of lands are coal lands under the provisions of the standards.

The first guiding regulations for the classification and valuation of public coal lands, approved by the Secretary of the Interior, April 8, 1907, prescribed a minimum workable thickness of coal of 2 feet and a maximum workable depth of 1,500 feet for coal land; all investigated lands that contained coal beds of less thickness or at greater depth were classified as noncoal. New regulations of April 15, 1908, retained the minimum thickness of 2 feet and prescribed a maximum depth of 3,000 feet for high-grade coal and 2,000 feet for certain thicknesses of low-grade bituminous and subbituminous coal. On April 10, 1909, the Secretary of the Interior approved regulations which fixed a minimum thickness of 14 inches and retained the maximum depth of 3,000 feet; the heating value of unweathered coal and the tonnage of coal underlying the land were factors used in the classification. About 4 years later the following regulations were approved on February 20, 1913, by the Secretary of the Interior (Smith and others, 1913, p. 96):

1. Land shall be classified as coal land if it contains coal having:
   (a) A heat value of not less than 8,000 Btu on an air-dried, unwashed or washed, unweathered mine sample.
   (b) A thickness of or equivalent to 14 inches for coals having a heat value of 12,000 Btu or more, increasing 1 inch for a decrease from 12,000 to 11,000 Btu, 1 inch for a decrease from 11,000 to 10,500 Btu, 1 inch for each decrease of 250 Btu from 10,500 to 10,000, and 1 inch for each decrease of 100 Btu below 10,000.
   (c) A depth below the surface for a bed of coal 6 feet or more thick of not more than 100 feet for each 300 Btu or major fraction thereof, and for a bed of minimum thickness for that coal a depth of not more than 500 feet, and for beds of any thickness between the minimum and 6 feet a depth directly proportional to that thickness within these limits, provided that, if the coal lies below the depth limit but within a horizontal distance from the surface not exceeding 10 times the depth limit, or if its horizontal distance from the foot of a possible shaft (not deeper than the depth limit) plus 7.5 times the depth of such shaft does not exceed 10 times the depth limit, the land shall be classified as coal land; provided, further, that the depth limit shall be computed for each individual bed, except that where two or more beds occur in such relations that they may be mined from the same opening, the depth limit may be determined on the group as a unit, being fixed at the center of weight of the group, no coal that is below the depth limit thus determined to be considered.
2. Classification shall be made by quarter-quarter sections or surveyed lots, except that for good reason classification may be made by 2½-acre tracts or multiples thereof described as minor subdivisions of quarter-quarter sections or rectangular lotted tracts.

Detailed stipulations for appraisal in dollars per acre of the coal lands were set forth in the regulations. They provided also that, after the valuation and the classification were made the lands should be restored to entry. After restoration, the coal lands could be acquired at the appraised prices and the noncoal lands should revert to the status which they had prior to the withdrawal.

A new set of standards for the classification of coal lands was approved by the Acting Director of the Geological Survey on September 1959. The principal deviation from the regulations of February 20, 1913, was a change from 6 to 8 feet for the maximum thickness of a bed of coal. It is apparent, however, that a 6-foot thick gently dipping coal bed can be classified at a greater depth by using the 1913 regulation (Smith and others, fig. 3) rather than the 1959 standards. The belt of land lying between the two depth limit lines would be classified as non-coal if the 8-foot maximum thickness is used but would be classified as coal land if the 6-foot maximum thickness is used.

PRESENT STANDARDS

The standards herein described for the classification of coal lands provide for (1) a maximum depth of 6,000 feet, (2) a maximum depth of 1,000 feet for coals of minimum thickness

(3) use of Btu values for as-received coal, (4) a minimum heat value of 4,000 Btu, (5) a minimum thickness of 14 inches for all coals that have a heat value of 12,000 Btu or more, and a maximum thickness of 6 feet for a coal that has a thickness of 6 feet or more (fig. 1).

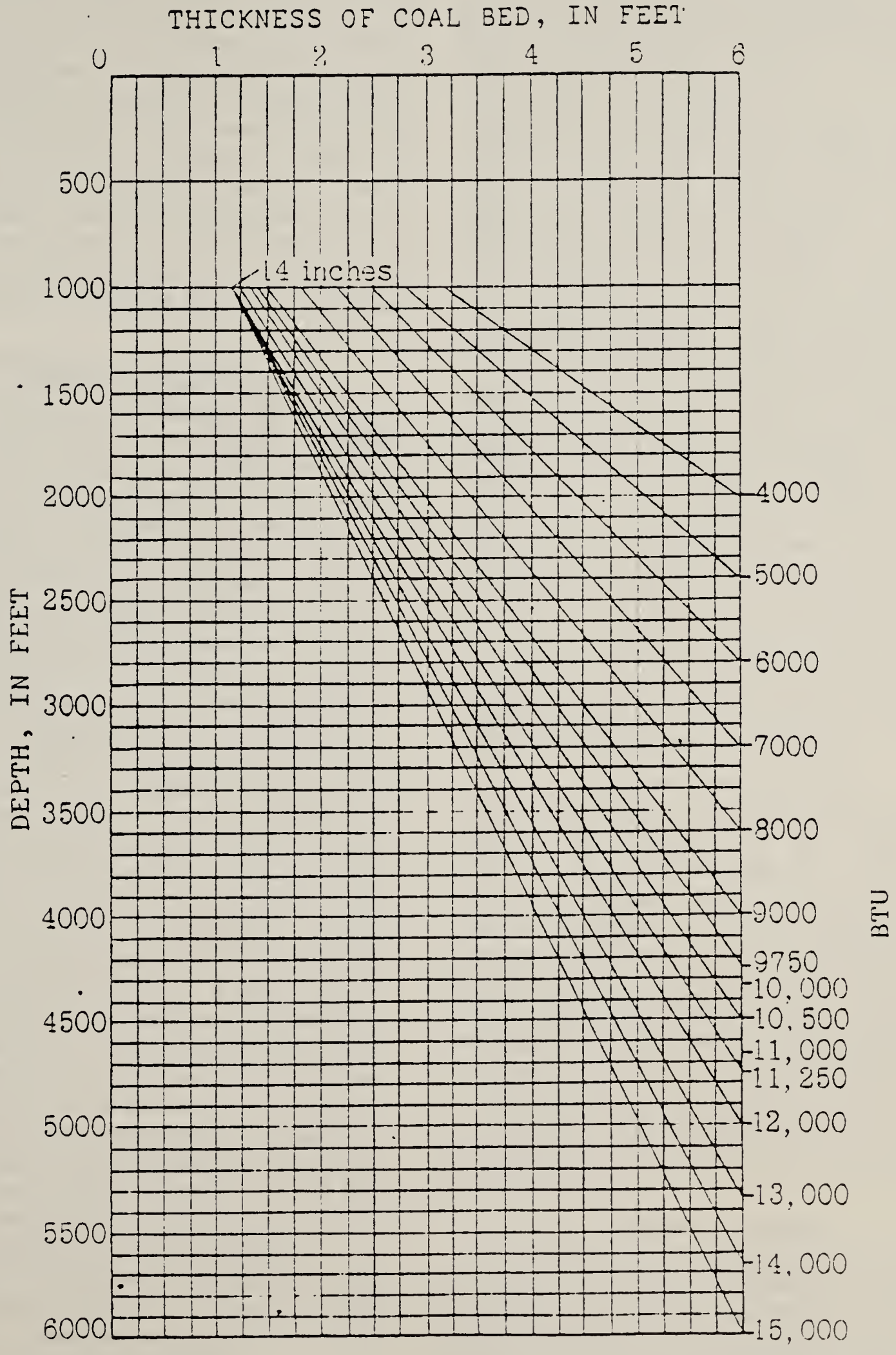


FIGURE 1.—Diagram showing depth limits of coals of different Btu (as-received basis) and of different thicknesses less than 6 feet.

MAXIMUM DEPTH

Smith and others (1913, p. 75) fixed a maximum depth of 5,000 feet for a coal that has an air-dried heat value of 15,000 Btu. They assumed for classification purposes "that a coal 6 feet or more thick is workable to a depth of 100 feet for each 300 Btu it contains." A maximum depth of 6,000 feet, which is 1,000 feet greater than the maximum prescribed in earlier regulations, is designated in the present standards because the advance in mining technology since 1913 appears to warrant the use of a greater maximum depth. Recent investigations of possible in situ exploitation of coal, if developed to a point where such operations are economic, may make a depth of 6,000 feet obsolete in the near future.

MAXIMUM DEPTH FOR COALS OF MINIMUM THICKNESS

A large increase in the mining of coal by stripping has taken place, particularly in recent years, since the regulations of 1913 were issued. The depth to which strip mining can be carried on economically has increased as machines and techniques have improved. Although the maximum depth of 500 feet prescribed in 1913 for coal of minimum thickness (Smith and others, 1913, p. 75) is adequate for present operations, a depth of 1,000 feet may be more realistic for the future. Moreover, the change to 1,000 feet will make the classification of coal lands conform more closely to the data on coal reserves published from time to time by the U.S. Geological Survey (Averitt, 1969). The selection of 1,000 feet as the maximum depth for coals of minimum thickness is particularly important in the lignite fields of North Dakota. Brant (1953) stated that, except for some buttes, in the southwestern part of the State where the lignite beds are at a depth between 1,000 and 1,200 feet, all minable lignite is at a depth of less than 1,000 feet. Most of these buttes, moreover, are in an area that was classified as coal land many years ago. Inasmuch as the greatest part of the resources of lignite and subbituminous *C* coal is in nearly flat-lying surface formations in the Dakotas, eastern Montana, and northeastern Wyoming, it is almost entirely at a depth of less than 1,000 feet.

Any land that contains a coal bed of the minimum thickness specified for its particular Btu value shall be classified as coal land for depths ranging between 0 and 1,000 feet.

USE OF AS-RECEIVED BTU VALUES

The rules for classification are modi herein to the extent that heat values for received coal shall be used instead of values air-dried coal as in the past, because of the c ditions in the laboratory where the analyses coal are made. These conditions are descri under the heading "Quality."

In order to make this changeover with causing large changes in the depth limits coals of various heat values, a comparison tween air-dried and as-received Btu values about 450 analyses of bituminous, subbitu nous, and lignite coals was made. It was fou that subbituminous *B* coal whose air-dried h value is about 10,000 Btu has an as-received h value of about 9,000 Btu. The comparison of cc of lower rank showed somewhat erratic diff ences, but comparison of coals whose heat va is more than 9,000 Btu showed the difference diminish fairly uniformly between 9,000 a 15,000 Btu. Accordingly, the spacing for Btu scale in figure 1 between 9,000 and 15,(Btu is uniform at 333 feet per 1,000 Btu; tween 9,000 and 4,000 the spacing is 400 feet 1,000 Btu. Although these two uniform sets spacing do not agree precisely with the compa sons between the two scales that were made w large groups of analyses, they do not devi from them by a great amount and they have merits of simplicity and uniformity.

MINIMUM HEAT VALUE

The regulations for classification of coal l approved on February 20, 1913 (Smith others, 1913) stipulated that any coal of pro thickness and depth that has an air-dried h value of 8,000 Btu or more is considered wo able and that land containing such coal is to classified as coal land. Advances in coal ben ciation and in the designs of steam plants si 1913, however, have made possible the comm cial use of coal that has a much lower Btu va Accordingly, it is considered advisable to lo the minimum Btu requirement for classif tion purposes to 4,000 Btu on an as-recei basis (fig. 1).

MINIMUM THICKNESS

An investigation of the commercial mining coal beds of various thicknesses was made connection with the preparation of the regu tions promulgated in 1913 (Smith and othe 1913, p. 69). It was found that the cost of m

ing coals less than 6 feet thick increases as the thickness decreases, that coals yielding 10,000 Btu were being worked "down to a thickness of 18 or 19 inches," that coals yielding 12,000 Btu were being worked "down to 14 or 15 inches," and that better coals were being mined from even thinner beds. In the light of these findings, a minimum thickness of 14 inches was fixed by Smith and others (1913) for all coals having 12,000 Btu or more (air-dried basis), the minimum increasing 1 inch for a decrease from 12,000 to 11,000 Btu, 1 inch for a decrease from 11,000 to 10,500 Btu, 1 inch for each decrease of 250 Btu from 10,500 to 10,000 Btu, and 1 inch for each decrease of 100 Btu below 10,000 Btu.

The minimum thickness of 14 inches is retained in the present standards; thus, the standards provide for a minimum thickness of 14 inches for all coals having 12,000 Btu or more (as-received basis), the minimum increasing 1 inch for each decrease of 750 Btu between 12,000 and 9,000 Btu, and increasing 1 inch for each decrease of 250 Btu between 9,000 and 4,000 Btu.

In the classification of lands that contain beds of lignite in North Dakota, South Dakota, and eastern Montana, the practice of the Geological Survey has been to use a minimum thickness of 2 feet 6 inches even though the heat value of the lignite varies rather widely throughout the region. Accordingly, in the present standards a minimum thickness of 2 feet 6 inches is fixed for a lignite that has an as-received heat value of 6,000 Btu. Inasmuch as the minimum thickness of a coal that has a Btu value of 9,000 is fixed at 1 foot 6 inches, which corresponds to the minimum thickness designated by Smith and others (1913, fig. 3) for the equivalent 10,000 Btu (air-dried basis), the minimum thickness for coals whose heat value ranges between 9,000 and 6,000 Btu (as-received basis) is increased 1 inch for each reduction of 250 Btu. Moreover, this same scale is extended to coals whose heat value ranges between 4,000 and 6,000 Btu (as-received basis).

MAXIMUM THICKNESS

The investigation conducted by Smith and others (1913, p. 74–75) of the cost of mining thick and thin beds of coal showed that there is little difference in the cost per ton for mining beds of coal 6 feet thick and those 10 feet thick or thicker. Accordingly, a maximum thickn of 6 feet was fixed in the regulations of 1913 ; is retained in the present standards. Any whose thickness is more than 6 feet is treated a 6-foot bed.

THICKNESS OF COAL BEDS CONTAINING PARTIN

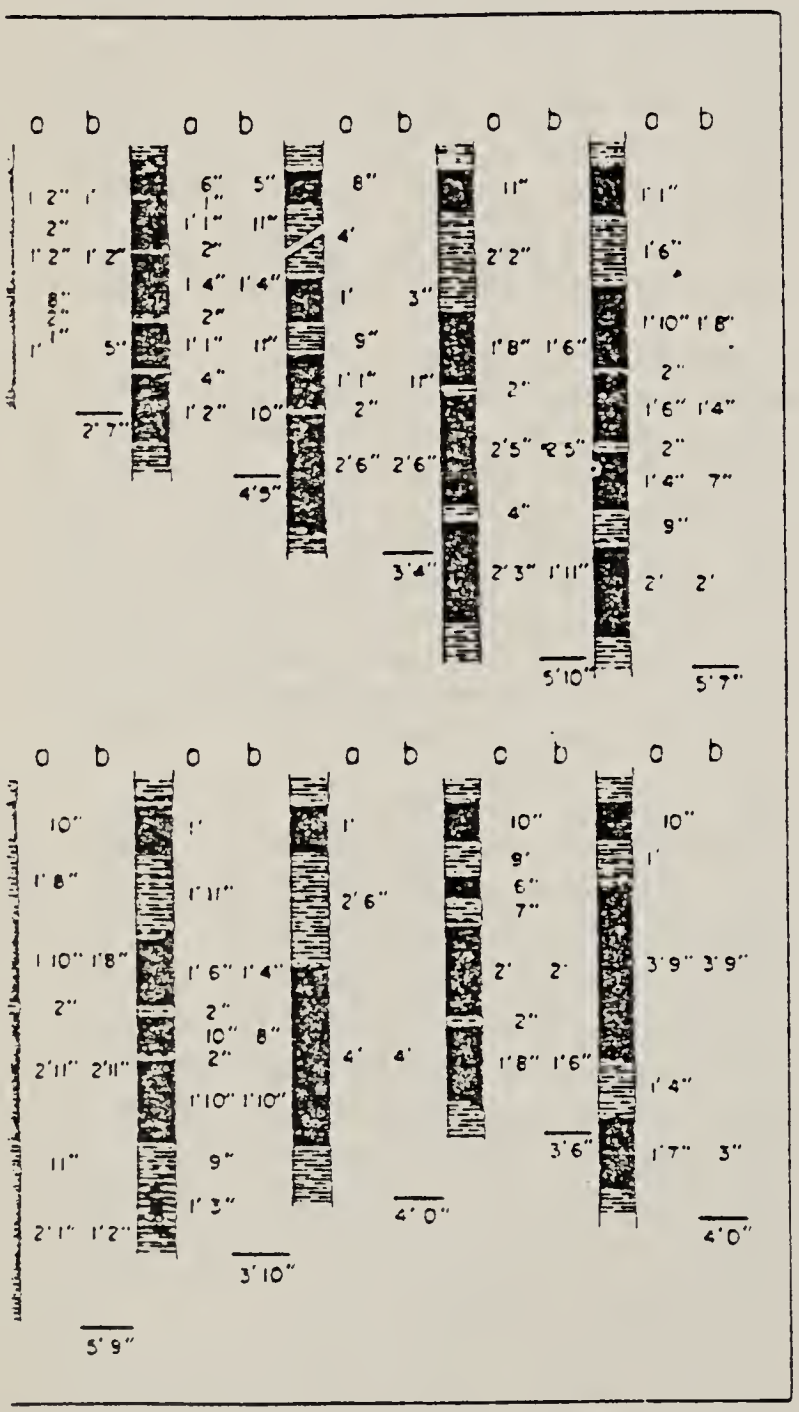
Coal beds that include partings have b treated uniformly by the Geological Survey many years, as prescribed by Smith and oth (1913, p. 70–71) after they had conducted investigation. They concluded that any part of bone or impure coal detracted from the va of the coal an amount equal to the thickness the parting. Two coal benches, each workal are treated as parts of a single bed if the thi ness of each bench exceeds the parting betw them and the parting does not exceed 3½ f Two thick benches of coal are treated as t beds if the thickness of the parting betw them exceeds the thickness of either one. A of coal 36 inches thick that includes a partin inches thick is regarded as being equivalent t solid bed 24 inches thick. The thickness of parting is deducted from the thinner of adjacent benches above and below it. To cal late the total thickness of a coal bed, start w the best bench and add the thickness of the n bench above or below it after deducting fr the coal bench a thickness equal to the thickn of the intermediate parting, and conti through the entire coal unit. If a parting thicker than the thinner adjoining coal ben that bench is considered as having no value. T practice is best illustrated by a group of c crete examples. (See fig. 2.)

TREATMENT OF COAL BEDS OF IRREGULAR THICKNESS

As pointed out by Smith and others (19 p. 72), the determination of the probable lim of workability of a coal bed that varies in thi ness from place to place is difficult. A few b of coal may maintain a nearly uniform thi ness over an area of several townships. In g eral, however, the thickness of most coal b varies widely and within short distances. T rules described by Smith and others (1913, 72–73) and quoted below are followed in present standards.

The simplest problem is that in which two uneq measurements on a single bed, taken at different pla are available. All such beds are assumed to grade u formly in thickness from the thicker measurement to

ough the thinner measurement, and a limit to the rkable coal is thus fixed that, while it may or may not ee with the unknown facts, is the most probable limit. general, a coal bed that can be traced continuously ng the face of a cliff, as can many beds in the West, usually been assumed to extend under the land back m the cliff at least one-half the length of the cliff outp, the lens or bed having the shape of a half-circle, length of the cliff outcrop being the diameter of the le. Obviously, if the outcrop runs along the cliff for ny miles, the extension of the coal back from the outp may be modified by many other factors. such as it of depth, or outcrop on the opposite side of the hill. he bed outcrops along the cliff with irregular thicks, only a moderate extension of the bed behind the f is assumed, the estimate being based on the charac- of the irregularities shown by measurements made ng the cliff, or by a general knowledge of the extent the lenses of that particular coal or of coals of that



URE 2.—Diagram showing split or broken beds and heir value for classification: a, measured thickness; , equivalent thickness used in classification and valation. From Smith and others (1913, fig. 2).

group, and depending on the general "habit" of the bed, if known, and also taking into account all local features. If the exposed outcrop does not extend in a straight line but, as is more common, runs in and out of ravines, careful note is made of the thickening or thinning of the coal between one point of measurement and another in order to detect, if possible, any general tendency of the bed to thicken or thin in any direction, and all these measurements and tendencies are taken into account in determining the probable extent of the lens in any direction.

Many beds studied are known to be of less than workable thickness in larger or smaller part, and any measurement showing a workable thickness on such a bed must usually be considered as a measure taken at the center of a small lens of workable coal. A discovery or measurement of a coal bed by a well, or by drilling, will have the same value as an isolated measurement on the outcrop. The content and shape to be assigned to any lens must depend on conditions and are largely matters of judgment, and such assignments or determinations especially require a wide knowledge of coals and of the particular group of coals to which the bed under consideration may belong.

Smith and others (1913) laid down explicit rules for treatment of special situations, such as groups of coal beds, coal beds in rugged terrain, and coal beds adjacent to a shaft. Inasmuch as these rules are not changed in the new standards, they are quoted herein.

TREATMENT OF A THIN COAL ASSOCIATED WITH A THICK COAL AND TREATMENT OF A GROUP OF COAL BEDS

The following material is quoted from Smith and others (1913, p. 75–77).

In general the limit of depth at which a coal bed may be profitably mined depends entirely upon the thickness of the bed and the quality of the coal. If, however, a thin but workable bed that lies below its ordinary minable depth is overlain by a thicker bed that lies within its own minable depth, the lower thin bed may, perhaps, be profitably worked by extending downward the shaft sunk to the higher, thicker coal, whereas the thinner bed could not have been profitably mined alone. A single shaft may also give access to all the coals of a group, and, though the cost of raising all the coal will be the same as if the coal were taken from a single bed, the cost of the shaft and the interest on that cost will be borne by the proceeds of a larger product. In some places the whole cost of a shaft may be borne by the coal of a thick bed that underlies several thinner beds or that lies in the middle of a group of thinner beds. It is clear that no two shafts that penetrate groups of coal beds will present similiar conditions. The coals of such groups will vary in number from two to twenty or more and may be included in an interval of 50 to 500 feet or more. Every case involving such conditions must be considered on its merits, and here again the Geological Survey has found it necessary to establish a series of general precedents in order to make its treatment of such cases reasonably uniform. In some places

it has been found possible to treat a group of coal beds as if they were all gathered at a "center of weight"—that is, at a point determined by multiplying the computed thickness of each bed by its depth from the surface and dividing the sum of the products by the sum of the compensated thicknesses, the thicknesses of the various beds being reduced for partings in the manner already described.

BURNED COAL

Coal is commonly burned along the outcrop in most coal fields in the Western States. Because burning bakes and hardens rocks overlying coal, ledges of baked rock in many shades of red and orange are characteristic features of the western coal fields. Commonly, the baked rock is less than 50 feet thick, but in places it is several hundred feet thick. The extent of burned coal back from the outcrop is believed to be indicated by the width of the band of reddened rock and soil; its width may be only a few hundred feet where the slope above the coal is steep and the cover is great, but its width may be one-quarter to one-half of a mile or more where the overburden is thin. The coal may be destroyed by burning where it lies near the tops of buttes and mesas. Characteristically, the band of burned rock is wide on narrow divides and narrow or absent in gulches. In fact, unburned coal commonly crops out in the troughs of gulches where they intersect the horizon of the coal bed. The field geologist should indicate the extent of the burned coal by appropriate symbols on his map. In classifying the land the edge of the coal is assumed to coincide with the boundary line for the burned areas.

QUALITY

The heat value of air-dried coal as expressed in British thermal units has long been used as a basis for determining the quality of coal for coal-land classification. As stated by Smith and others (1913, p. 68–69), coals that contain large percentages of mineral matter and moisture, which are the noncombustible constituents, show correspondingly lower heat values as expressed in Btu. On the other hand, coals that have small percentages of mineral matter and moisture contain large percentages of the combustible constituents in coal and therefore yield high heat values. It was these facts that caused the geologists who prepared the regulations of 1913 to stipulate a minimum value in Btu for coal in the land to qualify it as coal land rather than to set a maximum percentage of mineral ma and moisture in the coal as a determining fac

The rules for determining the minimum l value of any coal considered for classificatio the land and the depth limits of coals of dif ent heat values and different thicknesses h been based in the past on Btu values on an dried basis. Chemists of the U.S. Bureau Mines who make the analyses have pointed however, that heat values on an as-recei basis more nearly represent the true condit of the coal in the ground; furthermore, they more suitable for making comparisons of c of different rank. The Bureau of Mines disc tinued reporting the analyses for the air-dr category many years ago because, according R. F. Abernethy of the Bureau of Mines (wr ten commun. to A. F. Bateman, Jr., U.S. Geol ical Survey, Jan. 3, 1961),

The air-dry step in the preparation of a sample for laboratory is an intermediate operation and can v over quite a range. Samples of coal air-dried in wir may lose 5 to 8 percent more moisture than the sa samples air-dried in the summer. This is due to the r tive humidity of the air used in drying. The extreme this laboratory run from 0°F air heated to 86°F in winter time to air at 90°F and 90–100 percent rela humidity in the summer. The variation of the Btu samples air dried under the above conditions would so great they could not be compared.

DIAGRAM (FIG. 1) SHOWING DEPTH LIMITS OF COALS

The diagram, figure 1, was constructed to c form as closely as possible to the earlier d grams and yet to incorporate the changeo from air-dried to as-received Btu values. Fi the diagram, figure 3 of Smith and others (19 p. 76), was modified to incorporate a maxim depth of 6,000 feet. As modified, the figure 10,000 Btu (air-dried basis) coincides with 4,000-foot depth line. A compilation of the a dried and as-received Btu values for about 4 analyses of western coals showed that coals t have an average air-dried value of 10,000 B have an as-received value of 9,000 Btu. Acco ingly, the 9,000-Btu figure was placed in figu 1 at the 4,000-foot depth line. The 15,000-B figure was placed at the 6,000-foot depth li and the 2,000-foot interval between the 4,0 and 6,000-foot depths was divided into six equ intercepts, each of which represents a heat i crement of 1,000 Btu. Thus, each increment 1,000 Btu represents a depth change of 333 fe

The comparison of air-dried and as-received heat values for 450 analyses of western coals, referred to above, showed a more erratic distribution of values for coals that had heat values less than 10,000 Btu on an air-dried basis and 9,000 Btu on an as-received basis, presumably because of the higher moisture content of these coals, which in turn gave less uniform values when the coals were air dried in the laboratory. If the as-received values were to be placed on the diagram scale at the precise positions that correspond with the air-dried Btu values determined by the study of 450 analyses, the intercepts between 6,000 and 9,000 Btu would range between 180 and 340 feet on the depth scale and the intercepts for Btu values less than 6,000 Btu would have a much greater interval. It seems more sensible to apply a uniform scale to the Btu values for a diagram such as figure 1 rather than to plot irregular intervals based on comparisons of available analyses. The deviation from the actual value will not be large for any group of coals. Accordingly, as drawn, an increment of 1,000 Btu between 4,000 and 9,000 Btu represents a depth change of 400 feet.

As explained under the heading "Minimum thickness," the diagonal line that extends upward from the 6,000 Btu point terminates at 2 feet 6 inches because this thickness corresponds with the commonly used thickness cutoff for lignite that has low heat values. Thus, the difference in minimum thickness for coals whose heat values range between 6,000 and 9,000 Btu is 4 inches for each 1,000 Btu, or 1 inch for each 250 Btu. This scale is extended through the interval between 6,000 and 4,000 Btu.

The user of figure 1 should (1) obtain the as-received Btu value from chemical analyses of unweathered mine samples of the coal, (2) plot this Btu figure on the scale at the right margin of figure 1, (3) draw a diagonal line upward to the 1,000-foot depth line to determine the minimum thickness for the coal, and (4) if the coal is thicker than the minimum thickness, read the depth limit at the intersection of the diagonal line and the vertical thickness line. For example, an 8,000-Btu coal has a minimum thickness of 1 foot 10 inches. All land that contains this coal bed at depths between 0 and 1,000 feet should be classified as coal land. If the coal bed is 4 feet thick, its depth limit is 2,360 feet instead of 1,000 feet; if its thickness is 6 feet or more, its depth limit is 3,600 feet. Another example is a coal be that has an as-received Btu value of 5,000; if th bed is 2 feet 10 inches thick and at depths be tween 1 and 1,000 feet, the land containing i should be classified as coal land. On the othe hand, if the coal bed is less than 2 feet 10 inche thick, the land should be classified as noncoal

AREAL BASIS FOR CLASSIFICATION

Classification shall be made by quarter quarter section (40 acres), surveyed tract, o surveyed lot.

SUMMARY OF THE STANDARDS FOR THE CLASSIFICATION OF PUBLIC COAL LANDS

1. Land shall be classified as coal land if it contains coal having:
   (a) A heat value of not less than 4,000 Btu (as-received basis) for an unwashed or washed, unweathered mine sample.
   (b) A thickness of 14 inches for coals having a heat value of 12,000 Btu or more (as-received basis), increasing 1 inch for each decrease of 750 Btu between 12,000 and 9,000 Btu, and 1 inch for each decrease of 250 Btu between 9,000 and 4,000 Btu. Any coal bed whose thickness is more than 6 feet is treated as a 6-foot bed. In calculating the thickness of a coal bed that contains partings of shale, bone, or impure coal, the thickness of the thinner bench of coal directly above or below the parting is reduced by the thickness of the parting; thus, the total thickness of the coal bed (including partings) is reduced by twice the total thickness of the partings.
   (c) A depth of not more than 6,000 feet for a bed of coal 6 or more feet thick having an as-received heat value of 15,000 Btu. The depth decreases 333 feet for each decrease of 1,000 Btu between 15,000 and 9,000 Btu and decreases 400 feet for each decrease of 1,000 Btu between 9,000 and 4,000 Btu. For a bed of minimum thickness, the depth may not be more than 1,000 feet. For beds of any thick-

ness between the minimum and 6 feet, the depth is graduated between 1,000 feet and the maximum depth for a 6-foot bed. Moreover, the depth limit shall be computed for each individual bed except that, where two or more beds occur in such relations that they may be mined from the same opening, the depth limit may be determined on the group as a unit and is fixed at the center of weight of the group; no coal below the depth limit thus determined is to be considered.

2. Classification shall be made by quarter-quarter section, surveyed tract, or surveyed lot.

REFERENCES CITED

Averitt, Paul, 1969, Coal resources of the United States, January 1, 1967: U.S. Geol. Survey Bull. 1275, 116 p.

Brant, R. A., 1953, Lignite resources of North Dakota: U.S. Geol. Survey Circ. 226, 78 p.

Smith, G. O., and others, 1913, The classification of the public lands: U.S. Geol. Survey Bull. 537, 197 p.

☆U S. GOVERNMENT PRINTING OFFICE: 1970 O—402-462

RECEIVED
AUG 30 1974

AUG 27 1974

Conservation Division
U.S. GEOLOGICAL SURVEY
Office of the Area Geologist
Menlo Park, California

Memorandum

To: Conservation Managers, Eastern Region
Central Region
Western Region

From: Chief, Conservation Division

Subject: Instructions for preparation of a notice of KGS Definitions for the Federal Register

In a U.S. Geological Survey Manual release No. 1385 dated March 26, 1974, and Conservation Division Supplement release No. 18 dated April 10, 1974, the authority to determine the boundaries of defined KGS's and to publish notices of such determinations in the Federal Register was redelegated to the Conservation Managers. In order to insure that the notices submitted for publication in the Federal Register are standardized, a sample defined KGS notice listing several KGS's is enclosed. This format should be used in the preparation of all future KGS's notices. Whenever possible, a gang notice should be prepared rather than one for each individual KGS. An original and two certified copies should be set up for the appropriate Conservation Manager's approval and for the signature of the certifying officer on the two copies. The original and the two copies should be sent to the Chief, Conservation Division for transmittal to the Federal Register.

This delegation of authority should also appear on the KGS plat. Two copies of the KGS plats should be distributed to the following:

1. Land Office
2. District Engineer
3. Oil and Gas Supervisor
4. Area Geologist
5. District Geologist
6. Chief, Conservation Division
7. Chief, Branch of Mineral & Water Classification

Russell G. Wayland
Chief, Conservation Division

Enclosures

CD File
ADC/RE
Godwin
Schrott
RE chron.

Chief, ESP Section, Denver
Area Geologist, Eastern Area
Area Geologist, Denver
Area Geologist, Casper
Area Geologist, Roswell
Area Geologist, Tulsa
Area Geologist, Menlo Park
Area Geologist, Alaska

ROSchrott:jef 8-13-74

SAMPLE COPY

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

Definitions of Known Geologic Structures of Producing Oil and Gas Fields, Montana, Wyoming

Pursuant to 43 CFR 3100.7 and delegations of authority in 220 Departmental Manual 41. G, Geological Survey Manual 220.2.2B(2), and Conservation Division Supplement (Geological Survey Manual) 220.2.1F(2) notice is hereby given that the known geologic structures of producing oil and gas fields have been defined as follows:

Names of Field,	Effective Date,	Acreage
(26) MONTANA		
Goose Lake	March 28, 1973	9,966
(50) WYOMING		
Breen	December 29, 1972	1,480
Caan, Southeast	February 23, 1973	3,521
Kayo	January 17, 1973	10,740
Payne	January 12, 1973	5,003

Maps and diagrams showing the boundaries of the defined structues have been filed with the appropriate land office of the Bureau of Land

Management. Copies of the diagram and the land description may be obtained from the Regional Manager, U.S. Geological Survey, Building 25, Federal Center, Denver, Colorado 80225.

George H. Horn
Conservation Manager
Central Region

Date

Certified to be a true copy
of the original*

Alternate Certifying Officer

*Certification required on 2 carbon copies (does not appear on original)

CRITERIA FOR CLASSIFICATION OF OIL AND GAS LANDS

Land within a sedimentary basin or petroleum province shall be classified as valuable prospectively for oil and gas on the basis of several criteria; namely, thickness of sediments; evidence of oil and gas; and the presence, nature, and extent of folding and faulting.

Thickness. -- Areas known to have a sedimentary section of significant thickness are considered. This generally eliminates areas where original thickness of sedimentary rock is less that 1,000 feet, recognizing, however, that there are many productive sands that are found at depths less that 1,000 feet.

Maximum Depth. -- The lower depth limit of sediments is considered as 20,000 feet or more. This is based to some extent on the possible maximum drilling depth to an objective sand and the economic development of a productive sand.

Present Productive Areas. -- Present productive provinces are included. addition to the areas defined by productive or formerly productive .lls or fields, deeper undeveloped sands that may exist within the sedimentary basin are included, as well as stratigraphic traps and other untested structural traps. Included also are the known geologic structure of producing oil and gas fields. See 43 CFR 3120.2-2,3121.1-3122.3.

Classification of Known Geologic Structures. -- The regulations governing the definition of producing oil and gas fields are given in 43 CFR sec. 3120.2-2.

Classification by Legal Subdivisions. -- Classification shall be made by quarter-quarter sections surveyed tracts, or lots.

Classification by Legal Subdivisions.--- Classification shall be made by quarter-quarter sections, surveyed lots or tracts.

United States Department of the Interior

GEOLOGICAL SURVEY
WASHINGTON, D.C. 20242

RECEIVED
U.S. Geological Survey
MAY 17 1974
Conservation Division
Western Region
Menlo Park, Calif.

MAY 13 1974

cc: Gore
Odum
Schamber
P. Smith
Cullen
Keller
Dept. Sec.
5/17/74

Memorandum

To: Conservation Managers: Central Region
Eastern Region
Western Region ✓

From: Chief, Conservation Division

Subject: Delegated Authority to approve oil and gas sales contracts and agreements and to determine the boundaries of known geothermal resources areas and to publish notice of such determinations in the Federal Register

Geological Survey Manual release No. 1385 and Conservation Division Supplement release No. 18 containing the new and amended delegations of authority to and within the Conservation Division were recently distributed to your offices. Copies of our memorandum of February 22, 1974, proposing the subject delegations of authority are enclosed for your information.

The authorities delegated include delegations through and to the positions of Conservation Manager, Central, Eastern and Western Regions to exercise various functions relating to approval of oil and gas sales contracts and agreements and determination of the boundaries of known geothermal resources areas and the publication of notices of such determinations in the Federal Register.

All affected offices should commence exercising the functions delegated with respect to the approval of oil and gas sales contracts and agreements immediately. The functions delegated with respect to the determinations of the boundaries of known geothermal resources areas and the publication of notices of such determinations should also be exercised immediately by the offices affected. However, it is requested that until further notice, the executed and certified notices prepared for publication in the Federal Register be forwarded to this office for our review and transmittal, if in order, to the Federal Register for publication.

One of the earlier notices of the determination of the boundaries of known geothermal resources areas which was published in the

Federal Register is enclosed along with pertinent portions of the regulations governing preparation of notices for publication in the Federal Register. This published notice is being provided to serve as a model for the guidance of the offices affected in their preparation of notices for publication. We suggest that in lieu of the opening statement shown in that notice, that a statement to read somewhat as follows be used:

"Pursuant to the authority vested in the Secretary of the Interior by Sec. 21(a) of the Geothermal Steam Act of 1970 (84 Stat. 1565, 1572; 30 U.S.C. 1020), and delegations of authority in 220 Departmental Manual 4.1 H, Geological Survey Manual 220.2.3, and Conservation Division Supplement (Geological Survey Manual) 220.2.1 G, the following described lands are hereby defined as known geothermal resources areas:"

A. DEWEY ACUFF

Acting Chief, Conservation Division

Enclosures

FEB 2 2 1974

Memorandum

To: Director, Geological Survey

From: Chief, Conservation Division

Subject: Delegations of Authority

Proposed Geological Survey Manual and Conservation Division Supplement releases are enclosed. Said releases contain redelegations of authority through the line of command of the Conservation Division and relate to geothermal resource and mineral operations redelegations of authority contained in Part 220, Special Redelegation, of the Geological Survey Manual.

These releases redelegate back to the Area Oil and Gas Supervisor authority under 220.4.1F to approve oil and gas sales contracts and agreements. The authority to define known geothermal resource areas and to publish these definitions in the Federal Register is redelegated to Conservation Managers.

The redelegations of authority contained in the proposed releases affect the redelegations mentioned in your memorandum recommending approval of the proposed Departmental Manual release to delegate the authorities involved to the Director, Geological Survey. That release was subsequently issued on May 24, 1973, as D.M. release 1543. If you approve the proposed Survey Manual release, and have no objection to our proposed Conservation Division Supplement release, please return the latter for signature and publication.

Russell G. Wayland

Chief, Conservation Division

Enclosures

Order

Department of the Interior

GEOLOGICAL SURVEY MANUAL

CONSERVATION DIVISION SUPPLEMENT

Transmittal Sheet

Release No. 3/15/74

EXPLANATION OF MATERIAL TRANSMITTED:

This release contains the redelegation by the Chief, Conservation Division, of authorities pertaining to functions connected with geothermal resource and mineral operations to the Conservation Managers, Eastern, Central and Western Regions; the Conservation Manager, Gulf of Mexico OCS Operations; and other Conservation Division officials.

Chief, Conservation Division

FILING INSTRUCTIONS:

Remove Old Sheets:			Insert New Sheets:		
Part	Chapter	Sheet	Part	Chapter	Sheet
220	2	1 through 3	220	2	1 through 4

.1 Redelegation of Authority - Mineral Operations.

A. Application for Suspension of Operations. The authority redelegated by the Director to the Chief, Conservation Division, in SM 220.2.1A to approve applications for suspension of operations or production or both, filed pursuant to 43 CFR 3103.3-8 and 3503.3-2 and in terminating suspensions of this kind which have been or may be granted, is redelegated to the Conservation Managers, Eastern, Central, and Western Regions, and, subject to the direction and supervisory authority of the appropriate Conservation Manager, is further redelegated to the Area Oil and Gas Supervisors and Area Mining Supervisors.

B. Approval of Communitization or Drilling Agreements. The authority redelegated by the Director to the Chief, Conservation Division, in SM 220.2.1B to approve communitization or drilling agreements submitted for approval in accordance with 43 CFR 3105.2 is redelegated to the Conservation Managers, Eastern, Central and Western Regions, and, subject to the direction and supervisory authority of the appropriate Conservation Manager, is further redelegated to the Area Oil and Gas Supervisors.

C. Functions Relating to Unit Agreements. Subject to the limitations in the delegations of authority by the Director to the Chief, Conservation Division, in SM 220.2.1C(1) and (2), the authority under Section 5(a)(1) of the Outer Continental Shelf Lands Act of August 7, 1953 (67 Stat. 462, 464; 43 U.S.C. sec. 1334(a)(1)) to approve, in the interest of conservation, unitization, cooperative, pooling and drilling agreements, and to require lessees to subscribe to and operate under such agreements for the development and operation of an area, field or pool, or part thereof as determined to be practicable and necessary or advisable, and the authority under the Mineral Leasing Act of February 25, 1920 (41 Stat. 437), as amended (30 U.S.C. 181 et seq.) to approve, in the interest of conservation, agreements which provide for cooperative or unit plans of development or operation is redelegated to the Conservation Manager, Gulf of Mexico OCS Operations and to the Conservation Managers, Eastern, Central, and Western Regions, and, subject to the direction and supervisory authority of the appropriate Conservation Manager, is redelegated to the Area Oil and Gas Supervisors as to the following functions:

(1) Approve unit agreements submitted in identical form to that previously approved by the appropriate Conservation Manager where there is sufficient commitment to the agreement to assure effective control of operations within the unit area.

(2) Approve expansion or contraction of a unit area where such expansion or contraction has previously received the preliminary approval of the appropriate Conservation Manager.

(3) Approve an amendment of an approved unit agreement where the text of the amendment is identical to that previously approved by the appropriate Conservation Manager and where the owners of sufficient interests in the unitized land have executed said amendment.

(4) Concur in the operator's description of the lands automatically eliminated from a unit area under the provisions of the unit agreement.

(5) Approve the selection or designation of unit operators.

(6) Grant extensions of time for drilling test wells.

(7) Approve the establishment or revision of participating areas.

(8) Approve payment of compensatory royalty for drainage from unitized lands.

(9) Take appropriate action on commitment of interests to a unit agreement which are filed subsequent to approval of the unit agreement.

(10) Approve a request for the termination of a unit agreement where such request conforms to the procedures set forth in the unit agreement.

D. Discoveries of New Oil and Gas Deposits. The authority redelegated by the Director to the Chief, Conservation Division, in SM 220.2.1D to act on applications for royalty benefits by reason of a claimed discovery of a new oil and gas deposit under the Act of August 8, 1946 (60 Stat. 950), and to determine whether a new oil and gas deposit has been discovered, and the effective date of such discovery is further redelegated to the Conservation Managers, Eastern, Central and Western Regions.

E. Determinations of Productive Limits of a Producing Oil or Gas Deposit. The authority redelegated by the Director to the Chief, Conservation Division, in SM 220.2.1E to determine under the Act of August 8, 1946 (60 Stat. 950), the productive limits of a producing oil and gas deposit as such limits existed on August 8, 1946, on his own initiative or on application by a holder of an oil and gas lease or his operator is further redelegated to the Conservation Managers, Eastern, Central, and Western Regions.

F. Definition of Known Geologic Structures of Producing Oil and Gas Fields.

(1) The authority redelegated by the Director to the Chief, Conservation Division, in SM 220.2.2B(1) to determine the boundaries of the known geologic structures of producing oil and gas fields undefined, and to report such boundaries in memorandum reports to the appropriate Bureau of Land Management office, and to take further action to effectuate the Mineral Leasing Act of February 25, 1920 (41 Stat. 437), as amended (30 U.S.C. 181 et seq.) by also reporting to the appropriate Bureau of Land Management office the structural status of lands contained in an offer to lease oil and gas on Federal lands is redelegated to the Conservation Managers, Eastern, Central and Western Regions, and, subject to the direction and supervisory authority of the appropriate Conservation Managers, is further redelegated to the Area and District Geologists.

(2) The authority redelegated by the Director to the Chief, Conservation Division, in SM 220.2.2B(2) to determine the boundaries of known geologic structures of producing oil and gas fields defined to publish notices of such determinations in the Federal Register is further redelegated to the Conservation Managers, Eastern, Central and Western Regions.

G. Definition of Known Geothermal Resource Areas. The authority redelegated by the Director to the Chief, Conservation Division, in SM 220.2.3 to determine the boundaries of known geothermal resource areas under the Geothermal Steam Act of 1970 (84 Stat. 1566; 30 U.S.C. 1001-1025), and to publish notices of such determinations in the Federal Register is further redelegated to the Conservation Managers, Eastern, Central and Western Regions.

H. Oil and Gas Sales Contracts. The authority redelegated by the Director to the Chief, Conservation Division, in SM 220.2.1F to act for the Secretary of the Interior in approving oil and gas sales contracts and agreements filed pursuant to 30 CFR Part 223 is redelegated to the Conservation Managers, Eastern, Central and Western Regions, and, subject to the direction and supervisory authority of the appropriate Conservation Manager, is further redelegated to the Area Oil and Gas Supervisors.

Department of the Interior
GEOLOGICAL SURVEY MANUAL

Transmittal Sheet 3/15-/74

Release No.

EXPLANATION OF MATERIAL TRANSMITTED:

This release makes new delegations of authority and amends existing delegations of authority to the Chief, Conservation Division, in further implementation of the revision of the organization of the Conservation Division as set forth in 120 DM 4 (Release No. 1539, May 18, 1973). This release explicitly delegates to the Chief, Conservation Division, authorities delegated to the Director, Geological Survey, under 220 DM 4 (Release No. 1543, May 24, 1973), to determine the boundaries of known geothermal resource areas under the Geothermal Steam Act of 1970 and to approve oil and gas sales contracts and agreements filed pursuant to 30 CFR Part 223.

V. E. McKelvey

Director

FILING INSTRUCTIONS:

Remove Old Sheets:

Part	Chapter	Sheets:
220	2	1 and 2

Insert New Sheets:

Part	Chapter	Sheets:
220	2	1, 2 and 3

.1 Mineral Operations. The following authority which has been delegated to the Director by the Secretary of the Interior is redelegated to the Chief, Conservation Division:

A. Applications for Suspension of Operations. *(220 DM 4.1E).* To approve applications for suspension of operations or production or both, filed pursuant to 43 CFR 3103.3-8 and 3503.3.-2, and in terminating suspensions of this kind which have been or may be granted.

B. Approval of Communitization of Drilling Agreements. *(220 DM 4.1D To approve communitization or drilling agreements submitted for approval in accordance with 43 CFR 3105.2.

C. Functions Relating to Unit Agreements. (220 DM 2.1 and 220 DM 4.1

(1) Outer Continental Shelf Lands Act - Under section 5(a)(1) of the Outer Continental Shelf Lands Act of August 7, 1953, 67 Stat. 462, 464; 43 U.S.C. sec. 1334 (a)(1), to approve, in the interest of conservation, unitization, cooperative, pooling and drilling agreements, and to require lessees to subscribe to and operate under such agreements for the development and operation of an area, field or pool, or part thereof as determined to be practicable and necessary or advisable with the exception of such agreements involving submerged lands in the Santa Barbara Channel off the coast of California and agreements which would pool interests held under Federal submerged land leases with interests held under State submerged land leases.

(2) Mineral Leasing Act - Under the Mineral Leasing Act of February 25, 1920 (41 Stat. 437), as amended (30 U.S.C. 181 et seq.), to approve, in the interest of conservation, agreements which provide for cooperative or unit plans of development or operation with the exception of such agreements which anticipate or propose the use of nuclear explosives.

D. Discoveries of New Oil and Gas Deposits. (220 DM 4.1B). To act on applications for royalty benefits by reason of a claimed discovery of a new oil and gas deposit under the Act of August 8, 1946 (60 Stat. 950), and to determine whether a new oil and gas deposit has been discovered and the effective date of such discovery.

E. Determination of Productive Limits of a Producing Oil or Gas Deposit. (220 DM 4.1C). To determine under the Act of August 8, 1946 (60 Stat. 950), the productive limits of a producing oil and gas deposit, as such limits existed on August 8, 1946, on his own initiative or on applications by a holder of an oil and gas lease or his operator.

F. Oil and Gas Sales Contracts. (220 DM 4.1F). To act for the Secretary of the Interior in approving oil and gas sales contracts and agreements filed pursuant to 30 CFR Part 223.

G. Redelegation of Authority. This authority may be redelegated.

.2 Definition of Known Geologic Structures of Producing Oil and Gas Fields. Subparagraph *G,* 220 DM 4.1, provides that "The Director, Geological Survey, is authorized to determine the boundaries of the known geologic structures of producing oil and gas fields, under the Act of February 25, 1920 (41 Stat. 437), as amended (30 U.S.C. 181 et seq.)."

A. Procedure. Determinations of the boundaries of the known geologic structure of producing oil and gas fields are made in two manners:

(1) "Structures defined" are followed as soon after definition as practicable by the filing in the appropriate land office of maps or diagrams showing the structural boundaries, and by publication in the Federal Register of notices that such determinations have been made.

(2) "Structures undefined" are usually of a more temporary nature and maps or diagrams thereof are not filed and notices thereof not published; however, a memorandum of each such determination is filed in the appropriate land office and is available for public inspection.

B. Delegation of Authority.

(1) The Chief, Conservation Division, is authorized to act for the Director in determining the boundaries of known geologic structures of producing oil and gas fields undefined, and may report such boundaries in memorandum reports to the appropriate Bureau of Land Management office, and to take further action to effectuate the act by also reporting to the appropriate Bureau of Land Management office the structural status of lands contained in an offer to lease oil and gas on Federal lands.

(2) The Chief, Conservation Division, is authorized to act for the Director in determining the boundaries of known geologic structures of producing oil and gas fields defined and to publish notices of such determinations in the Federal Register.

(3) *Redelegation of authority.* This authority may be redelegated.

.3 Definition of Known Geothermal Resource Areas. (220 DM 4.1H). The Chief, Conservation Division, is authorized to exercise the authority delegated by the Secretary of the Interior to the Director, Geological Survey, to determine the boundaries of known geothermal resource areas under the Geothermal Steam Act of 1970 (84 Stat. 1566; 30 U.S.C. 1001-1025), and to publish notices of such determinations in the Federal Register. This authority may be redelegated.

GEOLOGICAL SURVEY CIRCULAR 419

THE DEFINITION OF KNOWN GEOLOGIC STRUCTURES OF PRODUCING OIL AND GAS FIELDS

By Emmett A. Finley

This report presents the procedures used by the Geological Survey in defining known geologic structures for leasing law administration

CONTENTS

	Page
Introduction	1
Interpretation	1
Purposes and timing	5
Procedure	5
Procedure for structure defined	5
Procedure for structure undefined	5
Termination	6
Appeal	6

ILLUSTRATIONS

Figure 1.	Plat of a defined known geologic structure	2
2.	Schematic representation of definition of known geologic structure	3
3.	Plat showing consolidation of several defined areas	4

THE DEFINITION OF KNOWN GEOLOGIC STRUCTURES OF PRODUCING OIL AND GAS FIELDS

By Emmett A. Finley

INTRODUCTION

On February 25, 1920, the President approved an act of the Congress designed to promote the mining of coal, phosphate, oil, oil shale, gas, and sodium on the public domain. This became the "Mineral Leasing Act of 1920," and, as amended, has been the basis for exploration and development of the named mineral commodities on Federal lands.

In that part of the Act pertaining to oil and gas, the following provisions were made:

> Sec. 13. That the Secretary of the Interior is hereby authorized under such necessary and proper rules and regulations as he may prescribe, to grant to any applicant qualified under this Act a prospecting permit, [amended to become a noncompetitive lease], which shall give the exclusive right for a period not exceeding two years [amended to five years], to prospect for oil or gas upon not to exceed two thousand five hundred and sixty acres of land wherein such deposits belong to the United States and are not within any known geologic structure of a producing oil or gas field * * *.

and,

> Sec. 17. That all unappropriated deposits of oil or gas situated within the known geologic structure of a producing oil or gas field and the unentered lands containing the same, not subject to preferential lease, may be leased by the Secretary of the Interior to the highest responsible bidder by competitive bidding * * *.

The bases for the determination whereby lands are leased noncompetitively or competitively remain unchanged as of the present. In an effort to provide the public with a better understanding of the procedures employed in differentiating competitive and noncompetitive lease acreage, this statement of the legal and geologic principles involved in determining "known geologic structures" is published.

The late John D. Northrop, former Chief, Branch of Mineral Classification, Conservation Division, Geological Survey, whose Survey career (1911-54) spanned the enactment of the Mineral Leasing Act of 1920 (41 Stat. 437), expressed the opinion in 1941 that no phrase in the general leasing law of February 25, 1920 (now known as the Mineral Leasing Act of 1920), has resulted in more speculation as to its precise meaning than the phrase "known geologic structure of a producing oil or gas field."

The boundaries of known geologic structures are determined by the Director, U.S. Geological Survey, by delegated authority from the Secretary of the Interior, as prescribed by 43 CFR 192.6. Plats (fig. 1) approved by the Director, Geological Survey, showing defined boundaries are placed on file in the local land offices of the Bureau of Land Management and in offices of the Oil and Gas Supervisors and Regional Geologists, Conservation Division, Geological Survey.

Known geologic structures are determined on a defined and undefined basis. The difference between them and procedures followed in determining each is discussed below.

INTERPRETATION

Through the years the Geological Survey has defined the known geologic structure of a producing oil or gas field as the trap, whether structural or stratigraphic, in which an accumulation of oil or gas has taken place. The limits of such structure include all acreage that is presumptively productive. On April 16, 1936, a decision by the Secretary of the Interior (Columbus C. Mabry, 55 I.D. 530) held (syllabus):

> The defining of the boundaries of the geologic structures of producing oil and gas fields, under authority of section 32 of the Leasing Act, is for administrative purposes and is not a guaranty of geologic character. Accordingly, such boundaries are not to be taken as absolutely and accurately showing the extent in each instance of the geological structure producing oil or gas, but they may later be extended or reduced to accord with the facts.

This premise recognizes that structural traps or "known geologic structures" can be more extensive than the pools of oil or gas they may contain. Known geologic structure definitions are made after evaluation of all controlling factors, and such definitions are made conformable to the dominant structural feature involved (fig. 2).

Where development shows that several fields, previously defined individually, actually coalesce and are in fact within the limits of the same geologic structure, it is administratively feasible to consolidate subordinate defined areas into a single area defined as the known geologic structure of a single field (fig. 3).

SALT CREEK FIELD

Ts. 39-40-41N. Rs. 78-79W., 6th. P.M., WYOMING

In accordance with Sec. 192.6, 43, C.F.R. I redefine the known geologic structure of the SALT CREEK FIELD as indicated hereon, revision effective November 22, 1954

	Acres
Total previously defined	24,233
Total additional	760
Total defined	24,993

November 22, 1954

Thomas B. Nolan
ACTING DIRECTOR
U.S. Geological Survey

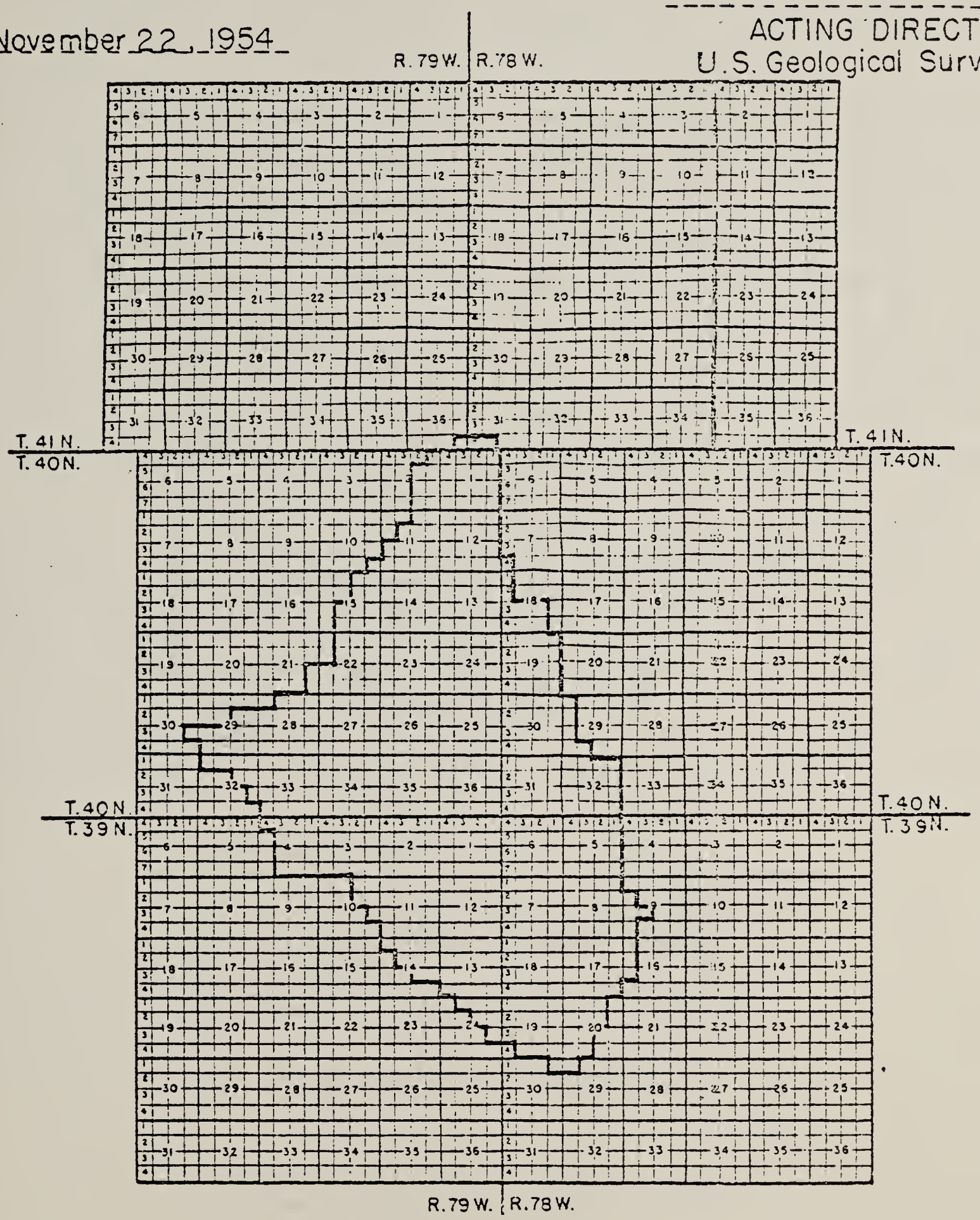


Figure 1.--Plat of a defined known geologic structure.

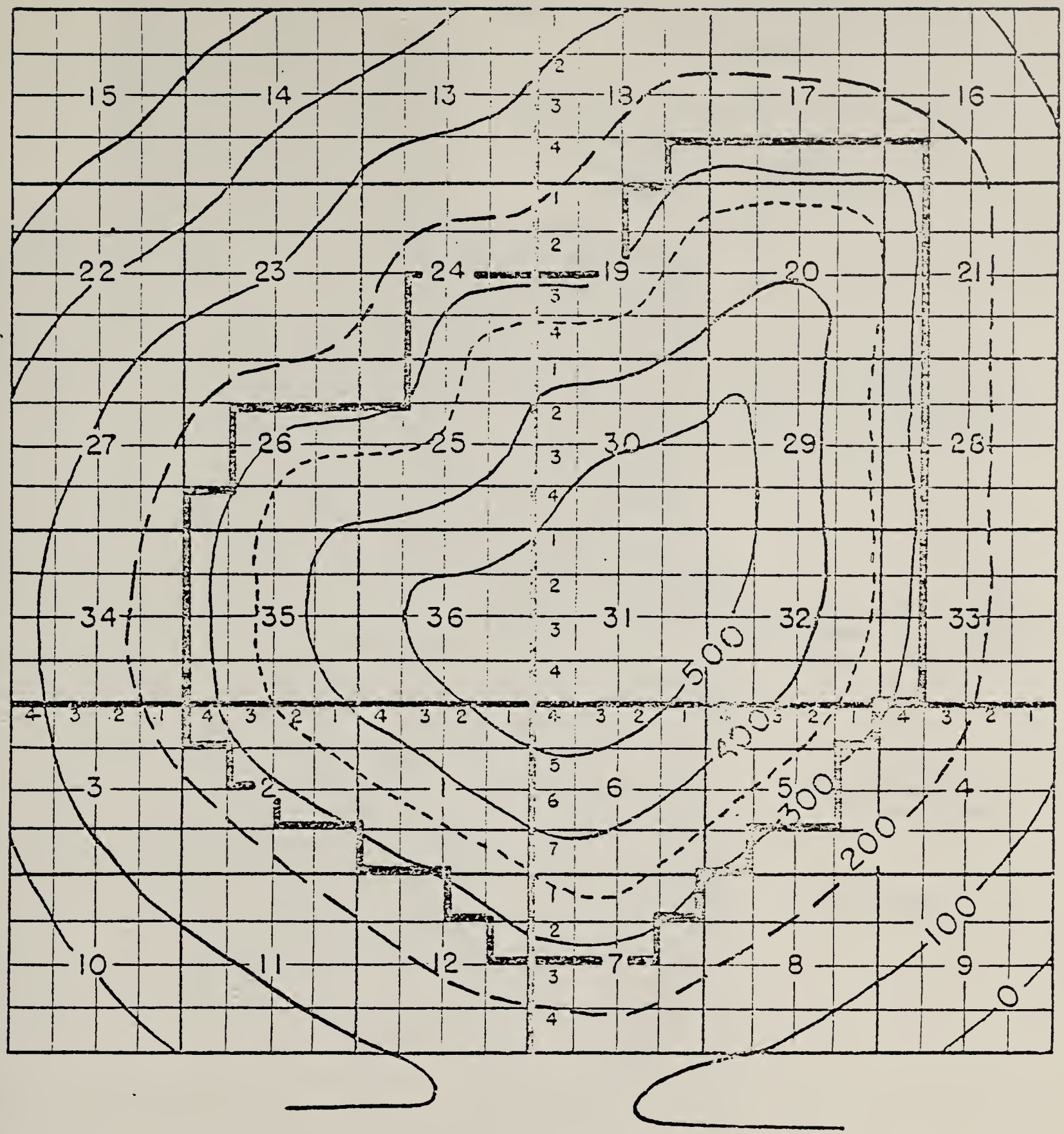
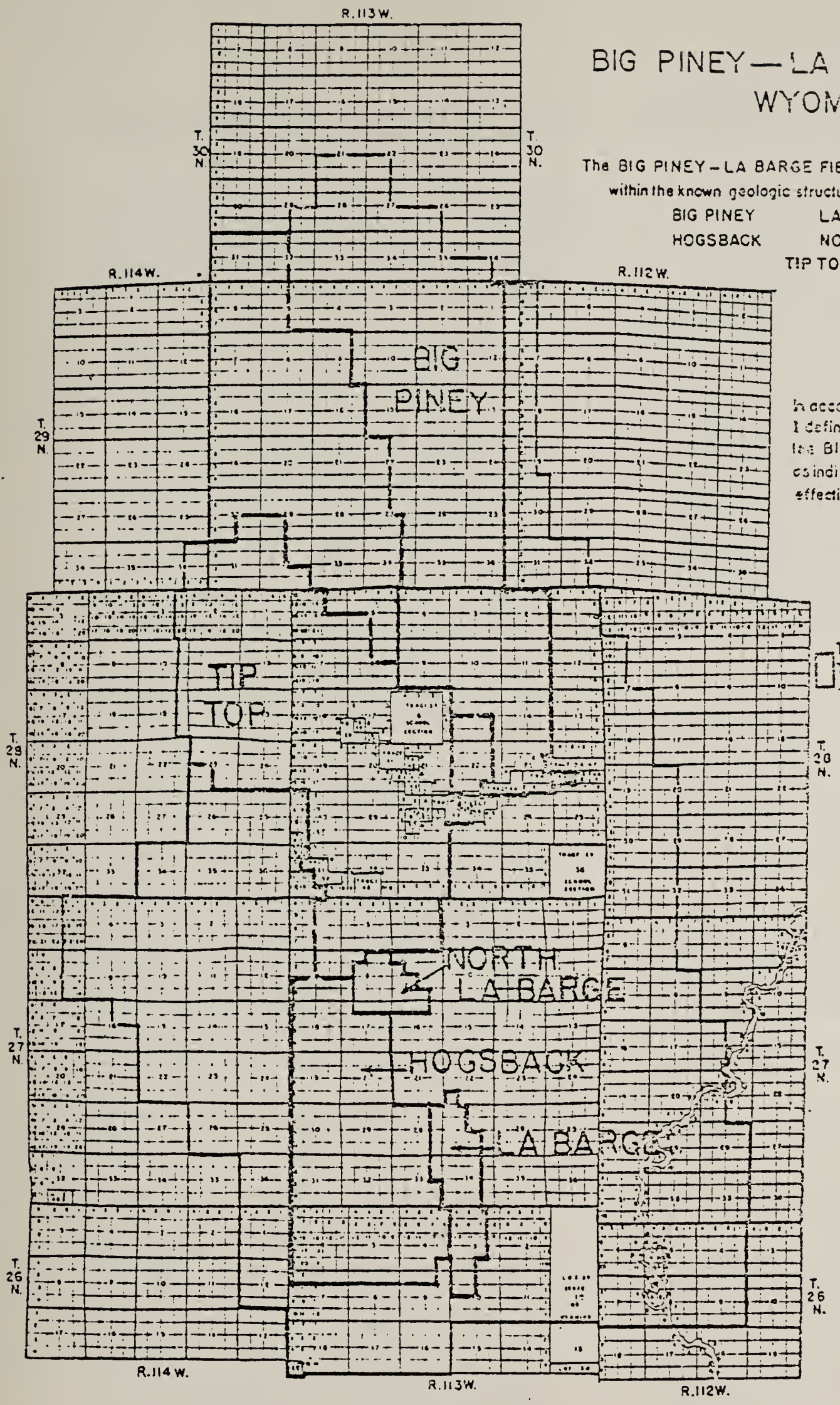


Figure 2.--Schematic representation of definition of known geologic structure.



BIG PINEY—LA BARGE FIELD
WYOMING

The BIG PINEY–LA BARGE FIELD includes areas previously within the known geologic structure of the following fields:

BIG PINEY — LA BARGE
HOGSBACK — NORTH LA BARGE
TIP TOP

In accordance with Sec. 192.6, 43 C. F. R. I define the known geologic structure of the BIG PINEY—LA BARGE FIELD as indicated hereon, revision & consolidation effective June 24, 1958

	Acres
Total previously defined	49,993.
Total additional	76,031.
Total defined	126,024.

ACTING DIRECTOR
U.S. Geological Survey

June 24, 1958

Figure 3.--Plat showing consolidation of several defined areas.

PURPOSES AND TIMING

Known geologic structure definitions distinguish lands to be leased competitively from lands that are subject to noncompetitive leasing, under Section 17 of the Mineral Leasing Act, as amended.

Acreage outside a known geologic structure of a producing oil and gas field as of the filing date of the application, if it is to be leased, is required by the Act to be leased to the first qualified person making application therefor, without competitive bidding. By instructions of April 23, 1921 (41 I.D. 98), the Secretary of the Interior stated:

> * * * it is clear that not only equitably but legally, qualified persons who filed proper applications for oil and gas prospecting permits under the Act of February 25, 1920, cannot and should not be deprived of their rights if, because of delay in action upon the applications so filed there intervenes a designation by this department of the lands as being within the geological structure of a producing oil or gas field occasioned by a discovery of oil or gas subsequent to the filing of the application in the local land office.

The prospecting permit applications referred to in the quotation are, in effect, the same as current applications for noncompetitive leases.

Acreage inside a known geological structure is subject to disposal by competitive bidding. The same decision (48 I.D.98) further states:

> * * * prospecting permits cannot be allowed within the geological structure of a producing oil or gas field, as known and existing at and prior to the filing of the application for the prospecting permit.

The filing date of the application for an oil and gas lease is the date considered in determining the structural status of the lands involved. The Department has long held that, if the structure underlying the tract of land is actually known to be capable of production prior to the date of the Department's official announcement, it is the date on which facts are available showing the lands to be on a producing structure, and not the date of the pronouncement to the public, that is determinative of rights which depend on whether the land is or is not situated within the known geologic structure of a producing oil or gas field. See Charles R. Haupt, 48 I.D. 355 (1921); A. W. Mason, 48 I.D. 213 (1921); Sun-Tex Petroleum Company, A-24453 (April 4, 1947).

PROCEDURE

Under the authority delegated by 43 CFR 192.6, the Director of the Geological Survey determines whether lands are or are not within any known geologic structure of a producing oil or gas field. In making these determinations it is recognized that the extent and position of any oil and gas accumulation in a known geologic structure, though primarily influenced by structure, is also influenced by such factors as stratigraphy, porosity, permeability, and by water and gas pressure in the reservoir. Evaluation of the net effect of these several factors is the result sought by the determination of definition of the known geologic structure. These determinations are for all purposes required by the provisions of the Mineral Leasing Act and the pertinent regulations, particularly,

1. For appropriate determination of the competitive and noncompetitive leasing provisions under Section 17 of the Mineral Leasing Act and 43 CFR 192.50, of the applicable regulations.

2. For appropriate application of the two- and five-year lease extension provisions under Section 17 of the Act and 43 CFR 192.120.

3. For appropriate application of the rental waiver provisions under Section 17 of the Act, and of the rental provisions of 43 CFR 192.80.

The Director's determinations require one of two procedures, namely, the procedure used in the determination of a geologic structure defined and the procedure used in the determination of a geologic structure undefined.

Procedure for structure defined

The geology of the structure is reviewed by a board of Survey geologists; their findings are submitted to the Director with a plat depicting the lands determined to be within the boundaries of the structure. Upon approval by the Director, copies of the plat are distributed to appropriate Bureau of Land Management and Geological Survey offices as mentioned in the Introduction. A notice stating that the determination has been made, and the effective date thereof, is published in the "Notices" section of the Federal Register.

Procedure for structure undefined

Inasmuch as definitions are required for purposes of administration immediately after the initial discovery is made in a new field, or extensions are made by outpost drilling, when knowledge both of the productive limits of the field and of the physical factors which determine such limits is at a minimum, known geologic structures undefined are established as an administrative expedient for appropriate action on the three regulations stated above.

The essential difference between defined and undefined known geologic structure definitions, and the reason therefor, is that the formality and detail in the defined procedure does not permit the necessary day-to-day determinations needed by the Bureau of Land Management in current administration of the leases and lease applications.

Undefined known geologic structures are of two types, namely:

1. An area where discovery necessitates the defining of a new productive area, and revisions thereof.

2. An area where development around a previously established defined structure warrants an extension of the established known geologic structure.

In connection with undefined geologic structures, available information, generally consisting of data relating to a single well or a few wells, together with available geologic information, is reviewed by geologists; and a memorandum is sent to the manager of the appropriate land office making a determination that certain lands are as of a certain date "on structure" or within an undefined addition to a previously defined structure. Although the lands determined to be on this structure are outlined on a work map, no plat is prepared for distribution or for filing in the Land Office, and notice of the determination is not published in the Federal Register because of its temporary nature.

Generally, the undefined structure procedure applies when there is a discovery on or near a Federal lease and an immediate determination is needed for guidance of the manager in administering the rental and extension provisions of the particular lease or leases in the vicinity of the discovery. It is also applied in areas where the scope and pace of development are rapid, and where the preparation and publication of a map would be misleading because, in a matter of a day or days after publication, or even on the date of publication, the boundaries are subject to change.

The undefined structure procedure is also used with respect to a field or area where there are but one or two tracts of Federal lands, and a determination can be made as to such tracts without the necessity of outlining the entire structure. This is especially true of the oil-producing States (Alabama, Arkansas, Florida, Illinois, Indiana, Kentucky, Louisiana, Mississippi, New York, Ohio, Pennsylvania, Texas, and West Virginia) where Federal acreage holdings are few and generally consist of widely scattered small parcels of lands.

As to the relative use of the two procedures, the undefined structure procedure is by far the more common practice. Consequently, in a great majority of determinations that certain lands are situated within the known geologic structure of a producing field, the determination is made without the preparation and filing of a plat of the structure.

The Department has consistently held that designation of undefined known geologic structures serves to withdraw lands from noncompetitive leasing. Administratively, an undefined structure has the same force and effect as the formally defined structure approved by the Director. See decisions--Ernest A. Hanson A-26375 (May 29, 1952); H. E. Christensen, A-26221 (August 31, 1951), where applications for noncompetitive leases and preference right leases were denied based upon Geological Survey reports that the lands were in "undefined additions" or "a proposed addition" to the known geologic structure of a producing oil or gas field.

TERMINATION

The question is sometimes raised as to the significance of the known geologic structure of a producing oil and gas field when oil and gas production no longer exists and such field is ostensibly abandoned. In unreported decision (A-6287) of March 24, 1924, the First Assistant Secretary of the Interior stated departmental policy in the matter as follows:

> The term "producing oil and gas field" as used in section 13 of the leasing act must be construed to include areas in which there has been production and which are capable of producing more oil, otherwise cessation of production in a given field because of a strike or other external matters would render areas which are clearly oil bearing, subject to prospecting operations * * *. Until further showings are made which are persuasive that the area does not still contain valuable deposits of oil the field will not be redefined.

For further support of this policy see decision of November 10, 1938 (56 I.D. 390).

When complete exhaustion and abandonment have taken place in all productive formations, and the capabilities of further production from untested sources appear negligible, the revocation of an outstanding definition is deemed unobjectionable. In a decision of October 28, 1947 (60 I.D. 62), the Assistant Secretary of the Interior stated:

> It is not the policy of the Department to redefine a geologic structure until all sands or formations therein having prospective value for oil and gas have been exhausted or proved barren.

APPEAL

Inasmuch as definitions (defined or undefined) of geologic structures are subject to the unpredictable vagaries of nature and to deficiencies in geologic information obtainable only after the drilling of additional wells, discrepancies are inevitable. Where a classification of lands by the Geological Survey is disputed by a base applicant, a request for reconsideration or protest may be made to the Director, or an appeal taken to the Secretary, in the course of which the person making the request, protest, or appeal has the burden of proving his position by competent geologic evidence.

INT. DUP., D.C. Sep. 35850

USGS-BR. of MINERAL CLASSIF.
RECEIVED
NOV 18 1970
MENLO PARK, CALIF.

CRITERIA FOR CLASSIFICATION OF OIL SHALE LANDS

Land shall be classified as oil shale land if it contains a continuous sequence of beds yielding not less than 18,000 barrels per acre (17,678 bbls. computed) under the following limitations:

(a) Minimum thickness of 15 feet yielding not less than 15 gallons per ton, or

(b) Any thickness less than 15 feet fulfilling the minimum yield requirement of 18,000 barrels per acre.

(c) Maximum depth -- The depths below the surface of a 15-foot bed of 15-gallon shale shall not exceed 5,000 feet. For shale of less thickness but yielding the minimum of 18,000 barrels per acre, the depth shall be in direct proportion of that thickness to 15 feet.

Classification by Legal Subdivisions. -- Classifications shall be made by quarter-quarter sections, surveyed tracts or lots.

EXECUTIVE ORDER

WITHDRAWAL OF PUBLIC OIL SHALE DEPOSITS AND LANDS CONTAINING SAME FOR CLASSIFICATION

Under authority and pursuant to the provisions of the act of Congress approved June 25, 1910 (36 Stat. 847), as amended by the act of August 24, 1912 (37 Stat. 497), it is hereby ordered that subject to valid existing rights the deposits of oil shale, and lands containing such deposits owned by the United States, be, and the same are hereby, temporarily withdrawn from lease or other disposal and reserved for the purposes of investigation, examination, and classification.

This order shall continue in full force and effect unless and until revoked by the President or by act of Congress.

HERBERT HOOVER

THE WHITE HOUSE,
April 15, 1930.

(No. 5327)

Executive Order

To Authorize Oil and Gas Permits and Leases on Withdrawn Oil-Shale Lands

Upon recommendation of the Secretary of the Interior, Executive Order No. 5327 of April 15, 1930, withdrawing certain lands for purposes of investigation, examination, and classification, is hereby modified to the extent of authorizing him to issue oil and gas permits and leases under the general leasing act of February 25, 1920 (41 Stat. 437–451), for any of the lands withdrawn by said order.

HERBERT HOOVER

The White House,

February 6, 1933.

[No. 6016]

U. S. GOVERNMENT PRINTING OFFICE: 1933

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Executive Order

MODIFICATION OF EXECUTIVE ORDER NO. 5327, OF APRIL 15, 1930, TEMPORARILY WITHDRAWING OIL-SHALE LANDS

By virtue of and pursuant to the authority vested in me by the act of June 25, 1910 (ch. 421, 36 Stat. 847), as amended by the act of August 24, 1912 (ch. 369, 37 Stat. 497), Executive Order No. 5327, of April 15, 1930, withdrawing oil-shale deposits and lands containing such deposits for purposes of investigation, examination, and classification, is hereby modified so as to authorize the Secretary of the Interior to issue sodium permits and leases under the General Leasing Act of February 25, 1920 (41 Stat. 437), as amended by the act of December 11, 1928 (45 Stat. 1019), for and of any of the lands withdrawn by said order.

FRANKLIN D ROOSEVELT

THE WHITE HOUSE,

May 13, 1935.

[No. 7033]

USGS-BR. OF MINERAL CLA
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MENLO PARK, CALIF.

CRITERIA FOR CLASSIFICATION OF PHOSPHATE LANDS

Western Fields

Land shall be classified as phosphate land under the following conditions:

Underground Mining:

(a) Thickness -- 3 feet or more.

(b) Quality -- 13.7 percent or more P_2O_5, 30 percent B.P.L.

(c) Depth -- less than 5,000 feet below surface, except for accessible horizontal beds.

Opencut or Strip Mining:

(a) Thickness -- 1 foot or more.

(b) Quality -- 24 percent or more P_2O_5, 52.4 percent B.P.L.

(c) Depth -- 0 to 150 feet or more, ranging from the surface for 1 foot of 24 percent P_2O_5 or 52.4 percent B.P.L., to 150 feet for 36 percent P_2O_5 content or 80 percent B.P.L. or more.

Eastern Fields

Land shall be classified as phosphate land under the following conditions:

(a) Thickness -- 3 feet or more.

(b) Quality -- 4 percent or more P_2O_5 (recoverable); 9 percent or more B.P.L.

(c) Depth -- less than 150 feet below the surface.

(d) Content -- 50 long tons or more of P_2O_5 per acre-foot or 109 long tons of B.P.L. per acre-foot.

(e) Core holes -- 1 hole showing minimum quality or better per 40 acre tract or legal subdivision.

(f) Common edge with 40-acre tract or legal subdivision classified as phosphate land by reason of a core hole or other tests.

(g) Less than 5 percent total content of ferric oxide plus aluminum oxide.

12e. Phosphate in the Western phosphate field. D. A. Jobin

Resources include all phosphate rock that may ultimately be found to be exploitable and include reserves which consist of the phosphate rock that is presently believed to be exploitable. If resources and reserves are defined as above, it follows that many actions taken by the Division hinge on the distinction between the two. To cite a few examples:

(1) Prospectively valuable maps outline areas having a resource potential.

(2) Classification standards define resources.

(3) Known leasing areas define areas known to contain reserves.

(4) Applications for prospecting permits are approved for lands that contain resources but are not approved if they contain reserves.

The inferred phosphate reserves and part of the resources for much of the Western phosphate field have been calculated recently by Sheldon[1] and Swanson.[2] Although neither made the distinctions outlined above (their calculations lump as inferred reserves that which we would separate into reserves and resources and no attempt was made to compute strippable reserves or resources), the methods and many of the parameters they used are identical with the methods and parameters outlined below.

The methods used to calculate reserves and resources are identical except that the parameters used for resource calculation, excluding those parts that are reserves, are usually less well defined. In either case, data that is needed consist of thickness, grade, depth of cover, structural configuration, and extent of phosphatic beds and their configuration with respect to the topography of the area they underlie. Both resources and reserves are reported as tons of phosphate rock qualified as to a range of grade and location with respect to entry level. A typical calculation would involve the following decisions and calculations given in the order they would be made:

(1) Define block for which reserves or resource is to be calculated; the chief factors considered here are structural configuration, entry level, number and spacing of sample localities, and maximum depth level.

(2) Divide the area of block into subunits with respect to entry level. The usual subdivisions are: (a) above entry level, (b) entry level to 1,000 feet below entry level, (c) 1,000-5,000 feet below entry level, (d) areas under 150 feet or less of cover susceptible to open-pit mining. The determining factor as to how far beneath entry level to carry your calculations is the maximum depth to which the thickness and grade allow you to consider the phosphate as a resource.

---

[1] Sheldon, R. P., 1963, Physical stratigraphy and mineral resources of Permian rocks in western Wyoming: U.S. Geol. Survey Prof. Paper 313-B, p. 49-273.

[2] Swanson, R. W., 1970, Mineral resources, Permian rocks of southwestern Montana: U.S. Geol. Survey Prof. Paper 313-E.

(3) Decide whether resources or reserves will be classed as measured, indicated, or inferred. Few, if any, areas other than working properties and leases have sufficient control to warrant calculating measured reserves or resources; most will contain only indicated or inferred reserves. Although many factors have to be considered, as a rule of thumb sample data sites less than 2 miles apart along strike and ½ mile across strike are necessary to calculate indicated reserves, and at least one sample data site per block or within 5 miles of a block are necessary to calculate inferred reserves.

(4) Planimeter area of block subunits, correcting for dip where necessary.

(5) Determine thickness of all phosphatic beds with an average grade higher than 13.7 percent P_2O_5, and the thickness of all phosphatic beds greater than 3 feet with average grades of from 18.0 to 24.0, 24.0 to 31.0, and above 31.0 percent P_2O_5.

Rules for calculation of thickness and grade of zones of phosphate rock:

(a) All zones must be greater than 3.0 feet, with the exception of (f) below.
(b) All zones must have a grade greater than 13.7 percent P_2O_5.
(c) The uppermost and lowermost beds must have a grade higher than the cutoff grade, with the exception of (f) below.
(d) No zone may contain a sequence of beds that are greater than 3.0 feet thick and contain less than the cutoff grade.
(e) For calculations of any one grade cutoff, no bed may be used more than once, but the same bed may be used for different grade cutoff calculations.
(f) If a phosphate bed is below required thickness, it may be combined with adjacent rock that is below grade cutoff, if the resultant 3-foot zone is above grade cutoff. If the adjacent beds are sampled, that grade will be used for calculations; if not, an average grade for that type rock will be used. Zones down to 1-foot thick under less than 150 feet of overburden and in relatively horizontal beds will also be calculated.
(g) Grade cutoffs will be 13.7, 18.0, 24.0, and 31.0 percent P_2O_5, and the average grade in the phosphatic members of the formation will be calculated.

(6) Multiply the thickness of each of the beds as determined above by the area of the block subunit to get the cubic feet of phosphate rock.

(7) Use following density factors to convert to tons of phosphate rock:

(a) 13.7-18.0 percent P_2O_5 have 12.5 cubic feet per ton.
(b) 18.0-24.0 percent P_2O_5 have 12.0 cubic feet per ton.
(c) 24.0-31.0 percent P_2O_5 have 11.5 cubic feet per ton.
(d) > 31.0 percent P_2O_5 have 11.0 cubic feet per ton.

An interesting statistic: a bed of high-grade rock (31.0 percent P_2O_5) 3.0 feet thick contains about 7,603,200 tons of ore per section, or at $7 per ton this means a section is underlain by ore worth approximately $53,222,400.

COMMITTEE

Minutes of the Mineral Land Classification Board

Date: February 2, 1974

Subject: Phosphate classification of lands in T. 39 N., R. 116 W., Sixth Principal Meridian, Teton County, Wyoming

Classification Committee Present: M. L. Schroeder, W. E. Bowers, and D. A. Jobin

T. 39 N., R. 116 W. is in Teton County, Wyoming. The township is unsurveyed except for secs. 1-3, 11-12, and 32, which were surveyed April 2, 1903, and parts of secs. 19, 27, 30 and 33, which were surveyed February 14, 1908; sec. 3 was partly resurveyed on April 14, 1916, and sec. 11 was partly resurveyed on July 31, 1916. The land grid for the remainder of the township was drawn from protraction diagram 11, September 7, 1961, as amended November 2, 1965. All sections are regular except the northern and westernmost tier. The township lies within both the Snake River Range and the Hoback Range, part of the Idaho-Wyoming thrust belt. About the western two-thirds of the township was withdrawn and included in Phosphate Reserve No. 4, Wyoming No. 1, approved July 2, 1910. Part of the township was classified as non-phosphate land and included in Phosphate Restoration No. 3, Wyoming No. 1, approved July 21, 1911; an additional part of the township was classified as nonphosphate land and included in Phosphate Restoration No. 23, Wyoming No. 8, approved February 28, 1916.

The basis for committee action is a geologic map published in 1968 of the Munger Mountain quadrangle (Albee, GQ-705) that covers most of the western part of the township. The northern edge of that part of the township is included in a geologic map of the Jackson quadrangle (I-769-A) by J. D. Love and H. F. Albee. The eastern part of the township was mapped by M. L. Schroeder in the summers of 1970-72 in conjunction with the mapping of the Camp Davis quadrangle (unpublished).

The geology was mapped on aerial photographs by both Albee and Schroeder. In the area mapped by Albee, the geology was transferred by inspection to an orthophotographic mosaic at a scale of 1:24,000 and subsequently traced onto a topographic base at the same scale. The data for the area mapped by Schroeder was compiled directly onto a 1:24,000 scale topographic base.

The ages of the exposed sedimentary rocks range from Mississippian to Late Cretaceous. A brief description of the rock units is included with the township map (pl. 1). The Darby thrust is the

dominant structural element and places folded rocks of the Madison to Aspen Formations on slightly folded rocks of the Bear River through Aspen Formations. Most of the folds and faults strike northwest to southeast as does the Darby thrust. Much of the township is covered by landslide deposits and surficial deposits; loess-covered terrace deposits are found in the northeast.

Both the lower and upper parts of the phosphate-bearing Phosphoria Formation crop out in secs. 28, 32, and 33, just west of the Darby thrust. Generally, the basal Meade Peak Phosphatic Shale Member contains the most productive phosphate beds in this part of the western phosphate field, although phosphate beds also are present in the upper Retort Phosphatic Shale Member.

The Phosphoria Formation was measured and sampled in the SW¼NE¼ sec. 32, T. 39 N., R. 116 W., Teton County, by R. G. Waring, M. A. Warner, R. A. Smat, and H. W. Pierce in June and August 1950, and stratigraphic measurements and phosphatic analyses were published by Sheldon (1963, p. 204, Stratigraphic section 57). The trench section and the analyses of the richest P_2O_5 samples are included and made a part of these minutes.

The Meade Peak in the trench (Sheldon, S-57) consists of interbedded phosphorite, siltstone, dolomite, and mudstone. This trench section contains a phosphate rock unit 3.6 feet thick near the base of the Meade Peak that averages 22.89 percent P_2O_5 classifiable to a depth of 200 feet.

Based on pertinent sample data, the geologic map and the known stratigraphic thicknesses, part of secs. 28, 32, and 33 is herein classified as phosphate land according to the Phosphate Classification standards as approved April 1, 1959. Only subdivisions that contain the outcrop of the Phosphoria Formation and its projected 200 feet classifiable depth limit are classified as phosphate land and except for these subdivisions the township is classified as nonphosphate land. The land in NW¼NW¼ sec. 28 is considered phosphate land even though the Phosphoria does not crop out because in cross section A-A' by H. F. Albee, the base of the Phosphoria on the anticlinal fold is within the 200-foot classifiable limit.

The following subdivisions embracing 317 acres are classified as phosphate land on the basis of the data cited above:

Sixth Principal Meridian, Wyoming

T. 39 N., R. 116 W., partly unsurveyed
sec. 28, NW¼NW¼, SW¼;
sec. 32, lot 2, NE¼NE¼;
sec. 33, NW¼NW¼.

The following subdivisions embracing 13,141.24 acres are classified as nonphosphate land on the basis of the data cited above:

Sixth Principal Meridian, Wyoming

T. 39 N., R. 116 W., partly unsurveyed
sec. 3, SE¼NW¼ (west part of lot 4), SW¼NW¼, SW¼;
sec. 4, NW¼NE¼, S½NE¼, NW¼, S½;
secs. 5 to 9, inclusive;
sec. 10, W½;
sec. 14, W½;
secs. 15 to 22, inclusive;
sec. 23, W½NW¼;
sec. 27, lot 5, W½NE¼, NW¼, N½SW¼, SW¼SW¼;
sec. 28, NE¼, NE¼NW¼, S½NW¼, SE¼;
secs. 29 and 30;
sec. 31, W½NE¼, W½, W½SE¼;
sec. 32, lot 1, NW¼NE¼, NE¼NW¼;
sec. 33, E½W½;
sec. 34.

Restoration of the lands classified herein is recommended.

Submitted and recommended by the Committee:

M. L. Schroeder — Member

W. E. Bowers — Member

D. A. Jobin — Member

Minutes by:
M. L. Schroeder

Reviewed by: _____ Date: 7-16-74

Approved by Mineral Land Classification Board:

_____
Member

_____
Member

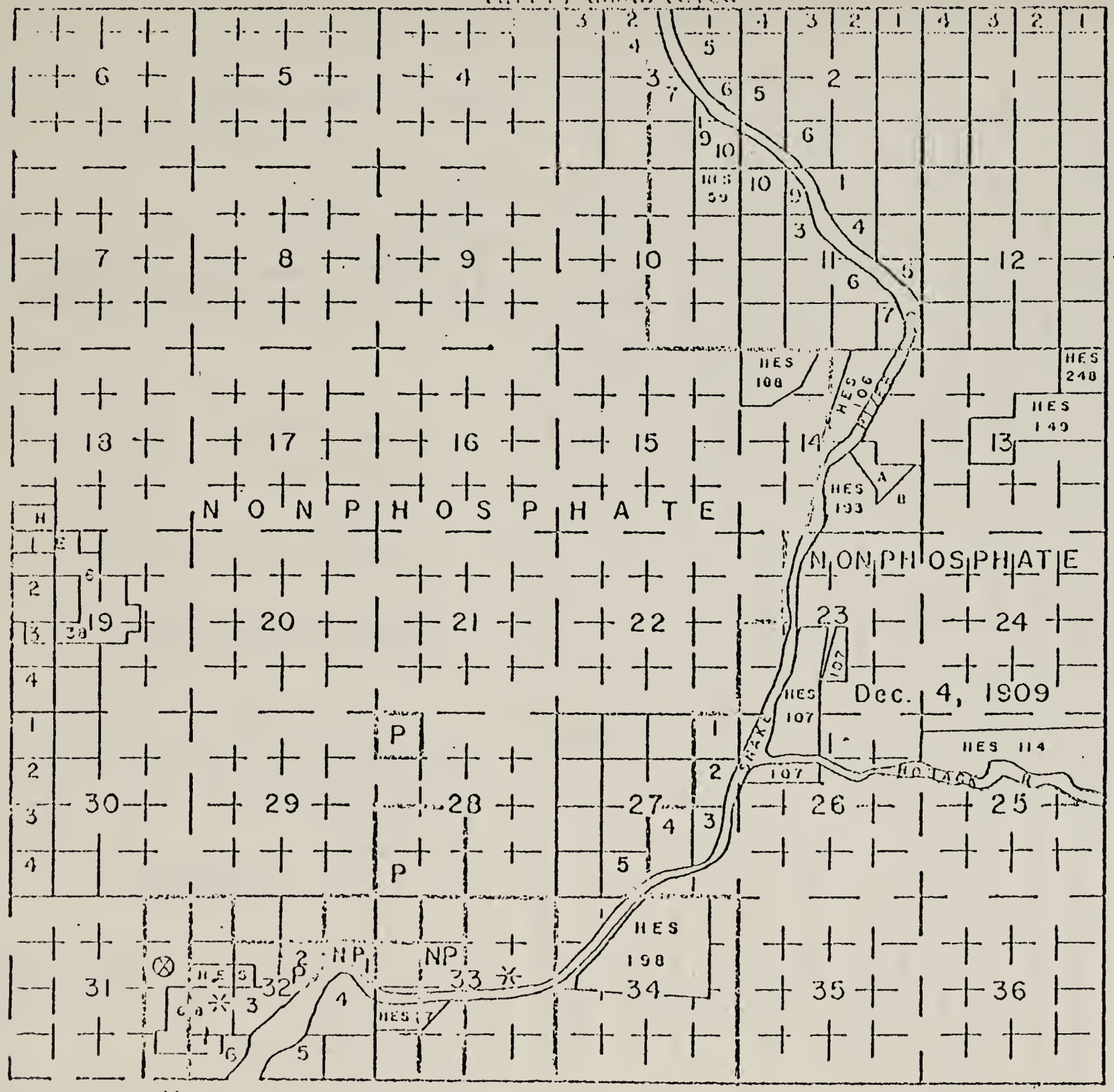
_____
Chairman

Date: _____

Enclosure: Classification Plat

cc: Area Geologist, CRMA
Area Geologist, NRMA
Chief, Br. of Min. & Water Class.
M. L. Schroeder
W. E. Bowers
Vernon Stephens, Western Area✓

TOWNSHIP 39 NORTH, RANGE 116 WEST, SIXTH PRINCIPAL MERIDIAN, WYOMING
Partly unsurveyed



✳ Nonphosphate - July 21, 1911
⊗ Nonphosphate - Feb. 28, 1916

PHOSPHATE

CLASSIFIED	Mineral	Nonmineral
Classified by this action	317	13,141
Reclassified by this action		
Prior classification*		8,811
Total acres classified to date	317	21,952

NOT CLASSIFIED	
Not withdrawn	
In outstanding withdrawal	
Restored without classification	
Total acres not classified	

Total acres in township 22,269

Classified on dates shown as:

Mineral ☐
Nonmineral ☐
Not classified ☐

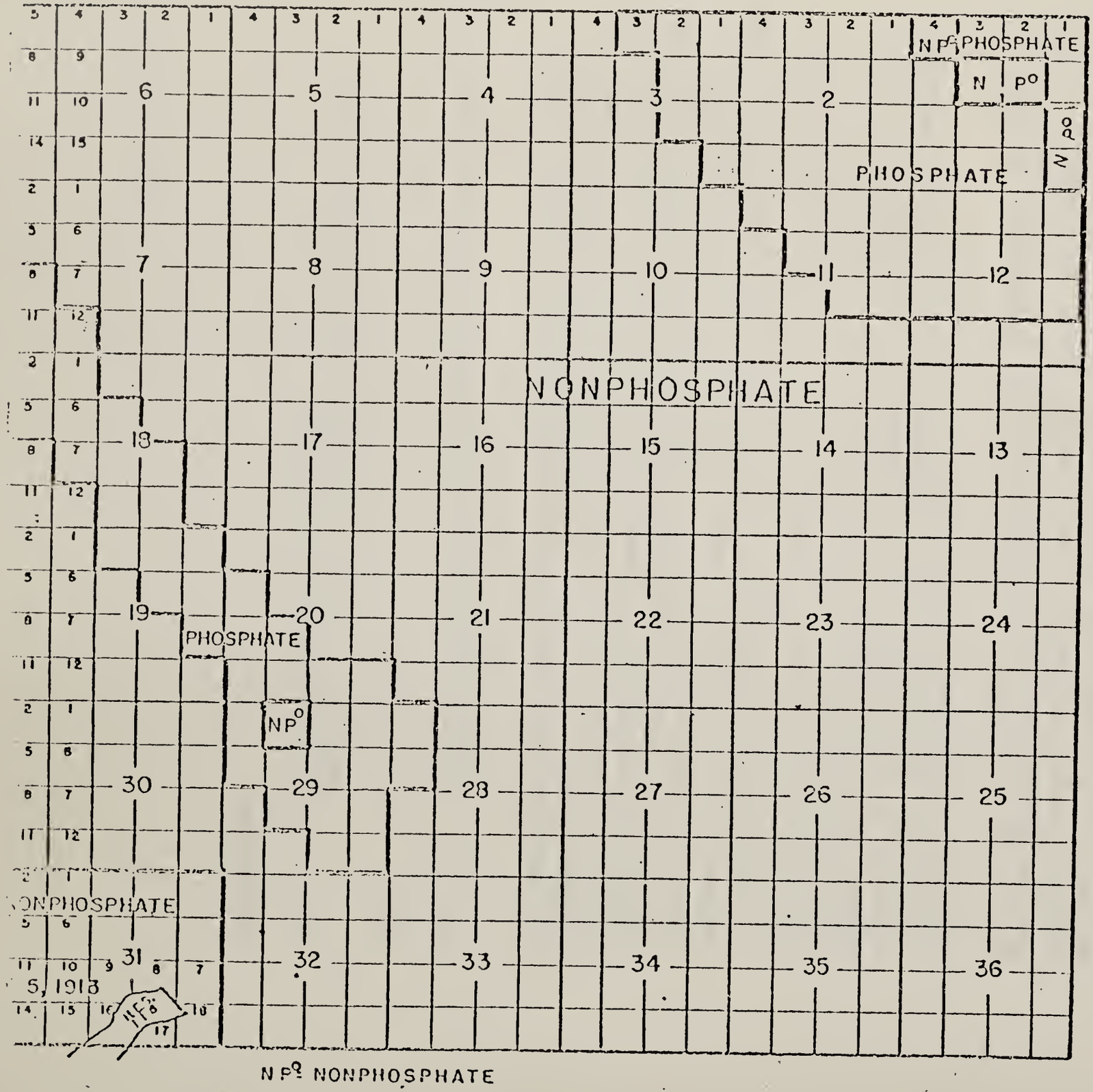
New classification approved by the Director, U. S. Geological Survey, ..., published in Federal Register v. ..., p. ...,

.....

Restored from ....., by Public Land Order ...., published in Federal Register v. ..., p. ...,

Township 3 N., Range 44 E. of the Boise Meridian, Idaho

Phosphate Classification



PHOSPHATE

CLASSIFIED	Mineral	Nonmineral
Classified by this action	3985	20,004
Reclassified by this action		
Prior classification		874
Total acres classified to date	3985	20,878

NOT CLASSIFIED	
Not withdrawn	
In outstanding withdrawal	
Restored without classification	
Total acres not classified	

Total acres in township 24,863

Classified on dates shown as:

Mineral ☐
Nonmineral ☐
Not classified ☐

New classification approved by the Director, U. S. Geological Survey, May 3, 1965, published in Federal Register v. 30, p. 6445, May 8, 1965.

Restored from ....., ..., by Public Land Order ....., published in Federal Register v. ....., p. ....., ...

April 9, 1965

Memorandum

To: District Geologist, Salt Lake City, Utah
Through: Regional Geologist, Rocky Mountain Region

From: H. F. Albee, W. C. Gere, D. A. Johns, and D. M. Schell

Subject: Minimum thickness and grade curve for use in determining "Known Phosphate Areas"

Enclosed for your consideration and guidance is a curve based on thickness and grade which we propose to use as a first guide in defining leasable areas. This is the curve used in preparing the Snowdrift Mountain "KPA" (memorandum of April 2, 1965). An area to be given further consideration as to its leasability would have to have a foot-percent phosphate value in excess of the minimum values used to plot this curve. Although the curve incorporates a perspective of workability since it is a departure from the minimum requirements for phosphate land classification (CFR Manual 613.4.38), it should be emphasized that this curve will be only one of several criteria used to determine the leasability of an area. Also, the curve has no official status and should not be referred to in KPA minutes or correspondence relating to a lease or prospect application. Its primary purpose is to promote consistency insofar as possible in KPA determinations.

The minimum thickness and grade curve was constructed as follows: The end points on the curve were determined by the minimum thickness and grades presently considered mineable under existing mining and milling technologies, i.e., for thin acid-grade rock 3 feet of 31 percent P_2O_5, and for thick furnace feed rock 20 feet of 18 percent P_2O_5. The shape of the curve between these end points was determined by keeping the increase in foot-percent values per foot constant throughout the curve, i.e., as there is a difference of 227 foot-percent between the fixed end points and the end points have a difference in thickness of 17 feet, there is a change of 13.35 foot-percent of the curve. The curve is defined by the following equation:

$$Y = \frac{93 + [13.35\ (X-3)]}{X}$$

where Y = percent P_2O_5
X = thickness in feet

In other words the curve was constructed so that as the thickness of the phosphate decreases, the grade increases at an accelerated rate and conversely as the thickness of phosphate increases the grade decreases much less rapidly. We believe that a curve of this kind accurately reflects the relationship between thickness and grade that control present-day exploitation and its use as proposed will adequately protect the government interest in the destruction of leasable phosphate lands.

H. F. Albee

W. C. Gere

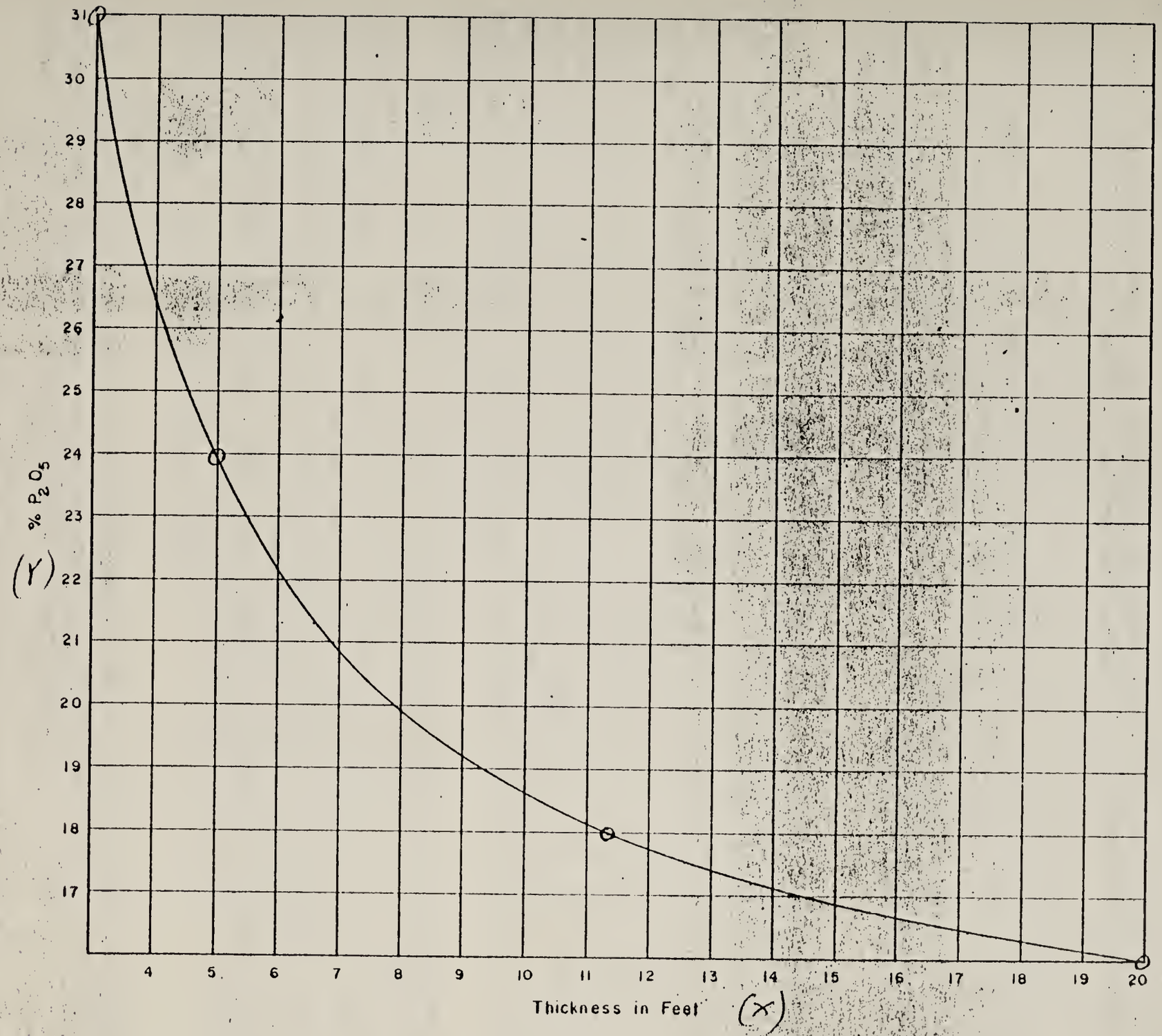
D. A. Jobin

E. M. Schell

Enclosure

cc: Gen. Corres. - Mineral Leasing
H. F. Albee
W. C. Gere
D. A. Jobin
E. M. Schell

DAJobin:ed



Minimum thickness and grade standards to be used in Known Phosphate Area classifications

$$Y = 93 + \frac{[3.35\,(X-3)]}{X}$$

2. Suggested criteria for establishing Known Phosphate Areas. D. A. Jobin

The procedure for defining a Known Phosphate Area is outlined in a general way in the BMC Manual, but the criteria to be used, other than a statement that the minimum standards will be the classification standards as modified by workability, are not detailed. Experience in establishing several KPA's has shown that a KPA is no more nor no less than the area underlain by reserves of phosphate sufficient to sustain mining operations for several years. Proceeding with the assumption that quantitative guidelines can be established on an empirical basis, we have developed the following specific criteria to distinguish potential KPA's.

(1) Minimum size. In the main part of the Western phosphate field, the minimum size of a reserve considered minable as a separate venture would be about the amount of ore found beneath one section. This would provide as a minimum between 2 and 3 million tons of acid-grade ore (> 31.0 percent P_2O_5) and several times this amount of furnace-grade ore (24-31 percent P_2O_5). In the outlying parts of the field where high-grade ores are in many places absent and total thickness of ore is thinner, the minimum size of a block considered minable would be two or three times as large, depending largely on the degree to which it would need beneficiation to bring the ore up to acid grade.

(2) Minimum thickness. This factor varies with both the type of mining methods used and the grade of the ore to be mined. In the Garrison mine, Montana, as little as 3 feet of acid-grade rock (> 31 percent P_2O_5) has proved minable by underground methods. In the same area 5-foot-thick beds of medium grade (24-31 percent P_2O_5) have also proved minable by underground methods. Inasmuch as high-grade beds are usually found overlain by or interbedded with medium- to low-grade beds, open pit mining has always resulted in mining thicknesses in excess of the minimum cited above. In the Vernal, Utah, area, extensive areas of low-grade to subgrade phosphate (16-24 percent P_2O_5) in gently dipping beds with little overburden range between 20 and 10 feet thick. San Francisco Chemical Co., the mine operator in the Vernal area, considers a 12-foot thickness minable if it is under less than 50 feet of overburden.

(3) Minimum grade. As cited under the discussion on thickness, minable grade is chiefly related to the kind of mining methods used as well as the thickness. Acid-grade rock (> 31.0 percent P_2O_5) is the desideratum for underground mines, but some mines take ore as low as furnace grade (24-31 percent P_2O_5). Many open-pit mines take ore to a minimum grade of 16 percent P_2O_5 and either concentrate by flotation and (or) washing to higher grades or blend with acid-grade material from the same or other properties for a furnace feed of 24-26 percent P_2O_5, often stockpiling the lowest grade rock (16-18 percent P_2O_5).

In summary:

(1) The minimum size that a block needs to be in order to be considered a potential KPA ranges from one section in the main part of the Western phosphate field to three sections in the fringe areas.

(2) Three feet of > 31.0 percent P_2O_5 phosphate rock is minable down to entry level.

(3) Five feet of 24.0 percent P_2O_5 phosphate rock is minable to entry level

(4) Twenty feet of 16.0 percent P_2O_5 is minable under 50 feet or less overburden by open-pit methods.

(5) An overburden to ore ratio of 4:1 is the maximum ratio in current minin

(6) The relationship cited in (2) through (5) can be summarized in an empirical curve (fig. 13) which then becomes a useful tool in appraising the potential of any area in the Western phosphate field to be classified as a KPA.

3. Status of formal withdrawals. M. L. Remley

The status of all withdrawals of all leasable minerals remains the same since 1960 except for the following (4) revocations (restorations).

Coal:

New Mexico -- one restoration.
An error on BLM's part restored a million and a half more acres than were withdrawn in all the coal withdrawals in New Mexico. However, there are still one and a half million acres to classify.

North Dakota -- one restoration.
17,779 acres.

Utah -- one restoration.
222,201 acres.

Phosphate:

Wyoming -- one restoration.
90,063 acres.

Discussion

The Conference members agreed that they would prefer to have lands restored as they are classified. These classifications would be more easily recognized as progress toward wiping out the withdrawals. The classified portions of the withdrawals restored at the time of classification would bring our accomplishments to the attention of interested parties.

(above entry level)

Monsanto) Soda
Stauffer) Springs

OPEN PIT ONLY (150' or less overburden)

% P_2O_5

29 28 27 26 25 24 23 22 21 20 19 18 17

4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

Thickness in Feet

San Francisco Chem
Vernal. 50'
overburde

Minimum thickness and grade standards to be used in KPA classifications

Figure 13

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
FEDERAL CENTER, DENVER, COLORADO

April 2, 1965

Memorandum

To: Regional Mining Supervisor, Branch of Mining Operations,
Salt Lake City, Utah
Through: District Geologist, Branch of Mineral Classificatio
Salt Lake City, Utah
Regional Geologist, Branch of Mineral Classificatio
Denver, Colorado

From: E. M. Schell, Denver, Colorado

Subject: Proposed known phosphate area of the Snowdrift Mountain area,
Caribou County, Idaho

By request of the Division Chief we are to provide data necessary to establish additional known phosphate areas (KPA's) similar to the Ashley Creek-Brush Creek, Utah KPA. Just for the record, the KPA classification is a joint effort of Branch of Mining Operations and Branch of Mineral Classification to outline the areas subject to lease and is not to be confused with Branch of Mineral Classification land classification program whereby the withdrawn land is classified as phosphate or nonphosphate without regard to whether the land should be subject to leasing or a prospecting permit.

Our present proposed KPA is the Snowdrift Mountain quadrangle. This is a joint effort among Dan Jobin, Howard Albee, and myself. Future proposed KPA's will include areas in Idaho where the geology is available on a 7½-minute quadrangle map. Enclosed is a map of the subject area with a proposed KPA outlined in red. We have tentatively outlined this area based on the existence, grade, and structure of the phosphate deposits. We would like you to examine the proposed KPA from the "workability" angle and give us your opinion on whether or not you agree with our proposed boundary and your recommendations for changes. Also, would you check our proposed KPA and include areas that are presently under lease or lease application.

The following general standards may be used to prepare the classification minutes:

1. A minimum of 3 feet of 31 percent P_2O_5 (based on the fact that this is considered economic in the Garrison, Montana area at present).

RECEIVED
FEB 25 1974
Conservation Division
U.S. GEOLOGICAL SURVEY
Moscow, Idaho

GEOLOGICAL SURVEY
APR 27 1965
SALT LAKE CITY, UTAH
MINING BRANCH

2. A minimum of 20 feet of 16 percent P_2O_5 for low-grade deposits (as used in the Ashley Creek-Brush Creek KPA minutes and based on the assumption that this is probably the lower limit of grade that can be beneficiated with present techniques). We are presently drafting a chart showing the minimum thickness and grade acceptable to meeting the KPA requirements. This will be forwarded to you for your approval.

3. Providing the deposit meets the above requirements then the structure is taken into account. Depending on complex structure a water level entry will be assumed as the maximum depth limit to be used in outlining the KPA.

The specific criteria used on the subject KPA are as follows:

a. All of the Phosphoria crop outside of the Webster syncline is either structurally disturbed or is just steeply dipping. Therefore, essentially just the outcrop of the Phosphoria Formation was blocked out.

b. In the Webster syncline, south of the tear fault, all of the syncline was included on the basis that this portion of the syncline is relatively free of faults and an operator would need the entire width of the syncline to make a minable block of ore. North of the tear fault the KPA was outlined on the basis of a 7,300-foot structure contour line which would be the height of an entry level on the Meade Peak. The reason for this is that there is some faulting involved on the northwest limb of the syncline, the syncline opens up, and additional structural complications may be present.

c. I don't believe there is any question about the thickness and grade of the phosphate. However, if you wish to look up some of this data the following trenches are in or adjacent to the subject area:

Lot 1264, W. Georgetown Canyon, Circ. 262.
Lots 1267 and 1267a, E. Georgetown Canyon, Circ. 262 and 375.
Lot 1268, Deer Creek, Circ. 208.
Lot 1392, Clear Creek, Circ. 375.
Lot 1372, Snowdrift Mtn. Circ. 327.

Most of this trench data is summarized graphically on Plate 7, Bull. 1153 and includes a slightly revised map of the area, additional cross-sections and a discussion of the geology.

Immediately upon agreeing on a boundary of the proposed KPA I will write Minutes of the Phosphate Board, similar to the Ashley Creek-Brush Creek KPA minutes. On the proposed KPA we would like to have one of the Branch of Mining Operations engineers on the committee, therefore, would you designate who this will be? The minutes will be revised until approved by all members of the committee who will then sign them.

I hope this will outline what we propose to do with the subject area and also future KPA's. Please expedite the review of the subject area.

E. M. Schell

E. M. Schell,
Geologist

Enclosure

cc: Chief, BMC, Washington, D.C.
BMC, Salt Lake City, Utah

United States Department of the Interior

GEOLOGICAL SURVEY
Box 25046
Denver Federal Center
Denver, Colorado 80225

IN REPLY REFER TO:

U.S.G.S. RECEIVED SEP 1 1976 CONSERVATION DIVISION

September 10, 1976

Current Example of Cover Memo

Memorandum

To: Chief, Conservation Division
Attention: ADC, Resource Evaluation, MS 640

From: Conservation Manager, Central Region

Subject: Knife River Known Coal Leasing Area, North Dakota

Enclosed is the following material for your review and further processing:

Original and six copies of North Dakota
Coal Land Leasing Minutes No. 3
Memo to State Director, BLM
Page-size diagram
Land description
Federal Register Notice.

This Knife River KCLA is assigned No. 3 since it replaces the previously submitted No. 3 (Beulah-Zap), No. 4 (Dunn Center), No. 6 (Hazen), No. 7 (Center-Stanton), and No. 9 (Underwood) which were returned by your office for revision.

Melvin Schweikert
for George H. Horn

Enclosures

cc: Area Geologist, NRMA

Example of Memo

AMERICAN REVOLUTION BICENTENNIAL 1776-1976

... the Secretary of Agriculture; ... until December 18 1983. ... shall be managed under the ... sustained yield and under ... practices for protection and ... of environmental quality ... than such management ... adjacent national forest ...

... conveyance to the subsurface ... land described above will be ... Koniag, Inc., pursuant to sec... the act, when conveyance is ... Chinkie Native Corporation ... estate.

... with Departmental ... 43 CFR 2650.7(d), notice of ... is being published once in ... REGISTER and once a week, ... consecutive weeks, in the ... DAILY TIMES. Any ... a property interest in ... by this decision may ap... to the Alaska Native ... Board, P.O. Box 2433, ... Alaska 99510 and with a ... upon the Bureau of Land ... and the Regional Solicitor, ... Solicitor, 1016 West Sixth ... 201, Anchorage, Alaska ...

... party receiving actual notice of ... shall have 30 days from the ... actual notice to file an appeal. ... unknown parties, any parties ... located after reasonable ef... been expended to locate, and ... who failed or refused to sign ... actual notice, shall have 30 ... the date of publication in the ... REGISTER, which is October 21, ... an appeal.

... known or unknown who ... property interest which is ... ected by this decision shall ... to have waived their rights ... adversely affected unless an ... timely filed with the Alaska ... Claims Settlement Board.

... summary dismissal of the ap... must be strict compliance ... regulations governing such ap... Further information on the man... and requirements for, filing an ... may be obtained from the Bureau ... Management, 555 Cordova ... Anchorage, Alaska 99501.

ROBERT E. SORENSON,
Chief, Branch of ... and Minerals Operations.

[FR Doc.76-27547 Filed 9-17-76;8:45 am]

[Serial No. A 9655]

ARIZONA

... Airport Leases; Application

SEPTEMBER 14, 1976.

... hereby given that pursuant to ... May 24, 1928 (49 U.S.C. 211-... E. Jenkins, has applied for ... lease for the following land:

GILA AND SALT RIVER MERIDIAN, ARIZONA

T. 7 S., R. 24 E.,
Sec. 10, Beginning at a point 470 feet West of the Northeast corner of the Northeast Quarter of the Northwest Quarter of said Section 10; thence South 1313 feet; thence West 50 feet; thence North 1313 feet; thence East 50 feet to the point of beginning, comprising an area of 1.51 acres.

The purpose of this notice is to inform the public that the filing of this application segregates the described land from all other forms of use or disposal under the public land laws.

Interested persons desiring to express their views should promptly send their name and address to the District Manager, Bureau of Land Management, Safford District Office, 1707 Thatcher Road, Safford, Arizona 85546.

MARIO L. LOPEZ,
Chief, Branch of Lands and Minerals Operations.

[FR Doc.76-27604 Filed 9-20-76;8:45 am]

[M 34989]

MONTANA

Proposed Withdrawal and Reservation of Lands

SEPTEMBER 10, 1976.

The Forest Service, United States Department of Agriculture, has filed application, M 34989, for the withdrawal of lands described below from all forms of appropriation under the public land laws including the mining laws, but not from leasing under the mineral leasing laws, nor the disposal of materials under the Act of July 31, 1947, as amended, 30 U.S.C. 601, 604 (1970).

The applicant desires the withdrawal to transfer jurisdiction of the national resource lands affected by rights-of-way for the Cottonwood Lakes Road No. 477.1; Cottonwood Ridge Road No. 5412; and South Cottonwood Road No. 5417 from the Bureau of Land Management to the Forest Service. This will enable them to protect the roads, which were jointly financed with private entities, by grants of easements for rights-of-way under the Act of October 13, 1964, 16 U.S.C. 532 (1970).

On or before October 21, 1976, all persons who wish to submit comments, suggestions, or objections in connection with the proposed withdrawal may present their views in writing to the undersigned officer of the Bureau of Land Management, Department of the Interior, P.O. Box 30157, Billings, Montana 59107.

The Department's regulation (43 CFR 2351.4(c)) provides that the authorized officer of the Bureau of Land Management will undertake such investigations as are necessary to determine the existing and potential demand for the lands and their resources. He will also undertake negotiations with the applicant agency with the view of adjusting the application to reduce the area to the minimum essential to meet the applicant's needs, to provide for the maximum utilization of the lands for the purpose other than the applicant's, to eliminate lands needed for purposes more essential than the applicant's, and to reach agreement on the concurrent management of the lands and their resources.

The authorized officer will also prepare a report for consideration by the Secretary of the Interior who will determine whether or not the lands will be withdrawn as requested by the applicant agency.

The determination of the Secretary on the application will be published in the FEDERAL REGISTER. A separate notice will be sent to each interested party of record.

If circumstances warrant, a public hearing will be held at a convenient time and place, which will be announced.

The lands involved in this application are:

PRINCIPAL MERIDIAN, MONTANA

T. 16 N., R. 14 W.,
Sec. 4, NE¼SE¼ and
Sec. 10, SW¼NW¼.

The area described contains 3.03 acres in Missoula County, Montana.

ROLAND F. LEE,
Chief, Branch of Lands and Minerals Operations.

[FR Doc.76-27605 Filed 9-20-76;8:45 am]

Fish and Wildlife Service

MARINE MAMMAL PERMIT

Receipt of Application

Correction

In FR Doc. 76-26263, appearing at page 37822, in the issue for Wednesday, September 8, 1976, change the comments date appearing in the last paragraph of the document on page 37826, from "November 8, 1976" to "October 8, 1976".

Geological Survey

PARIS-BLOOMINGTON, IDAHO

Known Leasing Area (Phosphate)

Pursuant to the authority contained in the Act of March 3, 1879 (43 U.S.C. 31), as supplemented by Reorganization Plan No. 3 of 1950 (43 U.S.C. 1451, note), and 203 Departmental Manual No. 1, and Secretary's Order No. 2948, Federal lands within the State of Idaho have been classified as subject to the competitive phosphate leasing provisions of the Mineral Leasing Act of Feb. 25, 1920 as amended (30 U.S.C. 211).

The name of the area, the effective date and the total acreage involved are as follows:

(12) IDAHO

Paris-Bloomington (Idaho) Known Leasing Area (Phosphate); October 10, 1975; 1,640 acres

A diagram showing the boundaries of the area classified for competitive leasing has been filed with the appropriate land

office of the Bureau of Land Management. Copies of the diagram and the land description may be obtained from the Regional Conservation Manager, Western Region, U.S. Geological Survey, 345 Middlefield Road, Menlo Park, California 94025.

W. A. RADLINSKI,
Acting Director,
U.S. Geological Survey.

SEPTEMBER 14, 1976.

[FR Doc.76-27606 Filed 9-20-76;8:45 am]

KNOWN GEOTHERMAL RESOURCES AREA

Leach Hot Springs, Nevada

Pursuant to the authority vested in the Secretary of the Interior by Sec. 21(a) of the Geothermal Steam Act of 1970 (84 Stat. 1566, 1572; 30 U.S.C. 1020), and delegations of authority in 220 Departmental Manual 4.1H, Geological Survey Manual 220.2.3, and Conservation Division Supplement (Geological Survey Manual) 220.2.1 G, the following described lands are hereby defined as a known geothermal resources area effective February 1, 1974.

(28) NEVADA

LEACH HOT SPRINGS KNOWN GEOTHERMAL RESOURCES AREA, MT. DIABLO MERIDIAN, NEVADA

T. 32 N., R. 38 E.
Secs. 13 and 14.
Secs. 23 and 24.
T. 33 N., R. 39 E.
Secs. 18 and 19.

The area described aggregates 3,840 acres, more or less.

FRED J. SCHAMBECK,
Acting Conservation Manager,
Western Region.

AUGUST 24, 1976.

[FR Doc.76-27607 Filed 9-20-76;8:46 am]

KNOWN LEASING AREA (PHOSPHATE)

Philipsburg-Maxville, Montana

Pursuant to authority contained in the Act of March 3, 1879 (43 U.S.C. 31), as supplemented by Reorganization Plan No. 3 of 1950 (43 U.S.C. 1451, note), and 203 Departmental Manual No. 1, and Secretary's Order No. 2948, Federal lands within the State of Montana have been classified as subject to the competitive phosphate leasing provisions of the Mineral Leasing Act of February 25, 1920, as amended (30 U.S.C. 211). The name of the area, effective date, and total acreage involved are as follows:

(26) MONTANA

Philipsburg-Maxville (Montana) Known Leasing Area (Phosphate); January 9, 1976; 22,165 acres.

A diagram showing the boundaries of the area classified for competitive leasing has been filed with the appropriate land office of the Bureau of Land Management. Copies of the diagram and the land description may be obtained from the Regional Conservation Manager, Central Region, U.S. Geological Survey, Mail Stop 909, Box 25046, Federal Center, Denver, Colorado 80225.

W. A. RADLINSKI,
Acting Director.

SEPTEMBER 14, 1976.

[FR Doc.76-27603 Filed 9-20-76;8:45 am]

National Park Service

NATIONAL REGISTER OF HISTORIC PLACES

Notification of Pending Nominations

Nominations for the following properties being considered for listing in the National Register were received by the National Park Service before Sept. 10, 1976. Pursuant to section 60.13(a) of 36 CFR Part 60, published in final form on January 9, 1976, written comments concerning the significance of these properties under the National Register criteria for evaluation may be forwarded to the Keeper of the National Register, National Park Service, U.S. Department of the Interior, Washington, D.C. 20240. Written comments or a request for additional time to prepare comments should be submitted by October 1, 1976.

JERRY L. ROGERS,
Acting Director, Office of Archeology and Historic Preservation.

ALABAMA

Tuscaloosa County

Tuscaloosa, *Capitol Park Historic District*, bounded by 9th St., 26th Ave., and the railroad tracks.

CALIFORNIA

Sonoma County

Cloverdale, *Cloverdale Railroad Station*, Railroad Ave.

GEORGIA

Fulton County

Atlanta, *Shrine of the Immaculate Conception*, 48 Hunter St., SW.
Atlanta, *Tompkins, Henry B., House*, 125 W. Wesley Rd., NW.

IOWA

Webster County

Ft. Dodge, *Oak Hill Historic District*, 8th-12th Sts., 2nd. and, 3rd Aves.

KANSAS

Sedgwick County

Wichita, *Long, Chester I., House*, 3401 E. 2nd St.

KENTUCKY

Franklin County

Frankfort vicinity, *Scotland (Scott-Mason-Taylor House)*, 5 mi. E of Frankfort on Versailles Rd.

Grayson County

Clarkson vicinity, *Grayson Springs*, jct. KY 88 and 1214.

SOUTH DAKOTA

Brookings County

Brookings, *Brookings County Courthouse*, St. and 6th Ave.

Brown County

Aberdeen, *Chicago, Milwaukee, St. P. Pacific Railroad Depot*, Main St. an road Ave.
Aberdeen, *Western Union Building*, Main St.

Butte County

Newell vicinity, *Belle Fourche Exp Farm*, off SD 79.

Codington County

Watertown, *Watertown Post Office*, Broadway.

Davison County

Mitchell, *Dakota Wesleyan Un* bounded by E. and W. Universit and McCabe St.
Mitchell, *Holy Family Church, Sch Rectory*, Kimball and Davison St and E. 3rd Aves.

Edmunds County

Ipswitch, *Beebe, Marcus, House*, 4th 5th Ave.
Ipswich, *Beebe, Marcus P., Library*, and 2nd Ave.
Ipswich, *Parmley Land Office*, Main tween 1st and 2nd Aves.

Kingsbury County

DeSmet, *Chicago Northwestern Depot*
DeSmet, *Kingbury County Courthous*

Lawrence County

Spearfish, *Halloran-Matthews-Brady* 214 E. Jackson St.

Pennington County

Hill City, *Harney Peak Tin Minin pany Buildings*, U.S. 16/85.

Perkins County

Lemmon, *Golden Rule Departmen* 201–203 Main St.
Lemmon, *Harriman, L. F., House*, Ave. W.
Lemmon, *Lemmon, G. E. House*, 507 W.
Lemmon, *Lemmon Petrified Park*, off

Roberts County

Sisseton, *Roberts County Courthous*

TENNESSEE

Franklin County

Belvidere vicinity, *Circular Barn at dale Farm*, S of Belvidere off U.S. 6
Winchester vicinity, *Simmons, Peter* about 11 mi. SW of Winchester on

TEXAS

Parker County

Tin Top vicinity, *Tin Top Str Bridge*, about 2 mi. S of Tin Top 1884.

Washington County

Chappell Hill, *Stage Coach Inn*, Chestnut Sts.

UTAH

Salt Lake County

Salt Lake City, *Orpheum Theatr* 2nd S.

[FR Doc.76-27095 Filed 9-20-76;8:

Minutes of the Mineral Land Classification Board

Date:

Subject: Standards for Classification of Lands for Retention of Sodium

Classification committee present: L. H. Godwin, G. A. Izett, and J. S. Hinds, Conservation Division

In consultation: G. I. Smith, Geologic Division

Introduction

The Act of March 3, 1879 (20 Stat. 377, 394) that established the U. S. Geological Survey provided, among other things, for the classification of the public lands for their mineral content. In order to assure uniform executive action in the classification of leasable mineral lands in the public domain for the purpose of retention of mineral rights, standards for determining which lands are mineral lands have been prepared from time to time by the U. S. Geological Survey. It is the duty of the Geological Survey to use geologic expertise to identify those lands within the public domain which are underlain by or have a reasonable expectation of containing leasable mineral deposits that meet or exceed the minimum limits set by these classification standards. Field examination and study of well data indicating the thickness, quality, quantity, attitude, and depth of beds precede classification. All known geologic facts are considered in determining which legal subdivisions of lands are mineral lands under the provisions of the standards.

The purpose of this report is to set forth changes in the classification standards for determining which lands in the public domain are classifiable as valuable or prospectively valuable for sodium mineral deposits under the Mineral Leasing Act of 1920 as amended (30 U.S.C. 181 et seq.) and under the Act of March 4, 1933 (30 U.S.C. 124). Section 23 of the Mineral Leasing Act of 1920, as amended, (30 U.S.C. 261) specifies that only chlorides, sulfates, borates, carbonates, silicates, and nitrates of sodium are leasable. Determination of which of the sodium-bearing mineral deposits are leasable is the responsibility of the Geological Survey because specific minerals were not named by the Congress. This provision of law assured that all valuable sodium deposits, including some not known to be valuable when the provision was enacted, would be considered and classified.

The new retention standards replace the classification standards of 1961 for sodium lands.

History

The first leasable alkali element to receive specific classification attention in our public domain lands was potassium. Because of the German monopoly on potash fertilizer production, Congress in 1911 and 1912 appropriated funds for a potassium study. The then Director of the U. S. Geological Survey, George Otis Smith (1913, p. 40), recommended "withdrawals to remain in force until Congress has provided more appropriate legislation than the existing placer law." The first potassium land withdrawal was made on January 16, 1913, and the original Potassium Leasing Act was enacted October 2, 1917 (40 Stat. 297).

Although lands containing all nonmetalliferous minerals, including sodium minerals, were made subject to withdrawal and classification under the Act of June 25, 1910, as amended by the Act of August 24, 1912 (43 U.S.C. 141-143), the Director (Smith, 1913, p. 142) concluded that at that time there was need for classifying only those lands valuable for coal, oil and gas, potassium, phosphate, nitrate, and asphaltic minerals. He added, however, that "should it be deemed by the President to be in the public interest to withdraw or to classify as mineral land an area containing any of these (nonmetallic mineral) deposits, because of a public need for a present or a future reserve supply, or with a view to preventing alienation of the mineral deposits under laws relating to nonmineral land, or as an aid to future disposition, his action would be based on a question of fact which it is the province of the Geological Survey to determine. So long as such withdrawal or classification is not deemed to be in the public interest, however, the land will remain open to exploration, discovery, occupation, and purchase under the mining laws unless Congress shall otherwise provide."

The Act of July 17, 1914 (38 Stat. 509; 30 U.S.C. 121-124) opened to agricultural entry lands that had been withdrawn or classified for oil and gas, potash, phosphate, nitrate, and asphaltic minerals, subject to reservation of the minerals to the United States. Sodium was not reserved originally in agricultural entries under the 1914 Act nor was it mentioned in the Potassium Leasing Act of 1917, but it was specifically included in the (General) Mineral Leasing Act of February 25, 1920 (41 Stat. 437; 30 U.S.C. 189 et seq.). This Act initiated the classification of lands as valuable for sodium and reserved the sodium minerals therein from location under the mining laws of 1872. Finally in 1933, sodium was added by amendment to the 1914 Agricultural Entry Act (47 Stat. 1570; 30 U.S.C. 124), and a general provision was added that "lands withdrawn, classified, or reported as valuable for any of the minerals named herein and/or in any of said Acts or upon which leases or prospecting permits have been applied for or granted, for the production of any of such minerals, shall not be subject to such appropriation, location, selection, entry, or purchase unless it shall be determined by the Secretary of the Interior that such disposal will not unreasonably interfere with operations under said leasing Acts." Thereafter, the procedures and standards used to determine whether

lands are classifiable as valuable for Leasing Act minerals have been the same as those used in connection with nonmineral entries under the public land laws. Lands known or reported to be valuable for minerals require a mineral reservation in surface entries and patents.

From 1920 until 1954, lands known to be valuable for Leasing Act minerals, including sodium, were closed to location and disposition under the Mining Law of 1872; however, sodium lands in San Bernardino County, California, were excluded from the mineral leasing laws until 1928 (45 Stat. 1019). The Multiple Mineral Development Act of August 13, 1954 (68 Stat. 708; 30 U.S.C. 521, et seq.) again made it possible to locate claims under the Mining Laws of 1872 on sodium lands, subject to reservation of deposits of sodium and other Leasing Act minerals.

A Land Classification Board was formally established within the Geological Survey in 1908. Today, the Mineral Land Classification Board is in the Branch of Mineral Classification, Conservation Division, Geological Survey. The Board is responsible for criteria or standards for the scientific classification of lands believed to contain deposits of leasable minerals and for determining whether lands under consideration meet minimum classifiable limits. The criteria and standards have long been available to the public upon specific inquiry and have been used in many land classification actions. In 1961, for administrative convenience, sodium standards were formally compiled by J. C. Miller and others in the form of Minutes of the Sodium Board, a unit of the Land Classification Board, and were approved by the Director, Geological Survey.

Sodium minerals and brines

The meaning of the term "sodium" has been defined broadly by the language of the Mineral Leasing Act of 1920 as amended. For the purposes of these minutes, a sodium mineral is here defined as any valuable mineral that contains the element sodium as an essential component of the mineral's crystal structure. It is not important insofar as land classification is concerned that other elements in the mineral may be more abundant than sodium. The sodium minerals most commonly found in bedded deposits are classified by the Geological Survey as valuable for sodium are listed with their chemical compositions in table 1. The list is representative rather than comprehensive. Detailed physical and chemical properties, crystal structure, and characteristic modes of occurrence of these minerals are described in standard mineralogy texts and mineralogic periodicals and are not repeated here.

[1]Act of March 3, 1879, sec. 1 (20 Stat. 394; 43 U.S.C., sec. 31(a); Reorganization Plan No. 3, of 1950, secs. 1, 2 (64 Stat. 1262; 43 U.S.C., sec. 1451, Note), effective May 24, 1950, 15 F.R. 3174; and Departmental Order No. 2563 of May 2, 1950.

All minerals in table 1, with the exception of the silicates, are soluble in dilute solutions of acids and most are soluble in water. They are evaporite minerals, precipitated from lake or sea water, or they have diagenetically replaced other materials. The solubility of the minerals in table 1, particularly some of the sodium borate and sulfate minerals, increases with temperature.

Brines classifiable qualitatively as valuable for sodium are generally but not necessarily those in which sodium is the most abundant cation. Some sodium brines are also valuable for potassium.

Brines of sodium differ significantly in composition. Several brines on and underlying the same land may be markedly different from each other. Many sodium brines are complex, containing other cations in various proportions, notably calcium, magnesium, and potassium but also strontium, rubidium, and lithium. The important anions of sodium brines are chloride, sulfate, carbonate, bicarbonate, borate, nitrate, bromide, iodide, and fluoride.

Sodium land classification factors

It is not necessary for the Geological Survey to have extensive drilling or geologic data to classify land as sodium land for retention of mineral rights, for this would eliminate large areas of undeveloped land that can, under applicable law and regulations, be inferred from fundamental geologic considerations to be valuable for sodium. If part of a legal subdivision is known to be underlain, or may be geologically inferred to be underlain, by a sodium deposit which meets the minimum standards for quality, thickness, and depth, the entire legal subdivision may be classified as sodium land.

A summary of the minimum thickness, maximum depth, and minimum quality standards required to classify Federal lands as sodium lands is presented in table 2. The sodium land classification standards of 1961 (J. C. Miller, unpub. information) are summarized in table 3. The chief differences between the 1961 standards (table 3) and the new standards (table 2) are that the maximum depth limit has been increased and the minimum quality has been decreased for the various sodium compounds and brines. The minimum quality for each group of sodium compounds is determined by selecting the common ore mineral of each group that has the least amount of anhydrous sodium compound (calculated) and using this amount as the minimum quality standard. For example, in table 2 the common ore mineral having the least amount of calculated anhydrous sodium sulfate is ~~mirabalite~~ bloedite

TABLE 2.--Summary of Sodium Land Classification Standards of this report (1972)

Standards		Sodium borates, carbonates, chlorides, and sulfates (ft.)				Sodium Silicates (ft.)
Maximum depth	Bedded deposits and brines	10,000 12,000				5,000
Minimum thickness of ore interval	Surface crusts	0.1				N.A.
	Near surface bedded deposits (to 300 ft. depth)	Varies from 0.5 ft. to 3 ft. The thickness to depth ratio is 1:100 below 50 ft.				Varies from 0.3 ft. t 3 ft. The thickness t depth ratio is 1:100 below 30 ft.
	Bedded deposits (greater than 300 ft. depth)	3				3
		Anhydrous sodium tetraborate (percent)	Anhydrous sodium carbonate (percent)	Sodium Chloride (percent)	Anhydrons sodium sulfate (percent)	Sodium silicate minerals (percent)
Minimum quality of ore interval	Surface crusts and bedded deposits (less than 300 ft. depth)	5	15	25	10	50
	Bedded deposits (greater than 300 ft. depth)	10	25	50	20	50
	Brines	0.5	2	2.6	2	N.A.

N.A. - Not applicable

TABLE 3.--Sodium Land Classification Standards of 1961

Standards		Sodium borates (ft)	Sodium carbonates (ft)	Sodium chlorides (ft)	Sodium sulfates (ft)	Sodium silicates (zeolites) (ft)
Minimum thickness	Bedded deposits	3	3	4	3	4
Maximum depth	Bedded deposits	5,000	5,000	5,000	5,000	5,000
	Brines	*	*	6,500	*	------
		B_2O_3 (percent)	Na_2CO_3 (percent)	NaCl (percent)	Na_2SO_4 (percent)	Zeolite minerals (percent)
Minimum quality	Opencut or strip	5	20	50	10	50
	Underground bedded	15	40	85	20	85
	Brines (artificial)	10	15	25	15	------
	Brines (natural)	1.0	3	10	3	------
		B_2O_3 (short tons)	Na_2CO_3 (short tons)	NaCl (short tons)	Na_2SO_4 (short tons)	Zeolite minerals (short tons)
Minimum quantity	Bedded deposits	7,800	8,700	12,000	11,000	12,000
	Brines (artificial)	*	*	*	*	------
	Brines (natural)	*	*	*	*	------

* Not specified.

Classification by legal subdivision

Classification of lands valuable for sodium is made by legal subdivisions defined as quarter-quarter sections, surveyed tracts, or surveyed lots. The sodium board abides by the established principle in public land management that if part of a legal subdivision contains or may be geologically inferred to contain part of a sodium deposit or brine body that meets minimum standards for quality, thickness, and depth, the entire legal subdivision (usually 40 acres) is classified as sodium land. The Sodium Classification Board considers that sodium deposits not extending over the entire legal subdivision should, in addition to meeting the standards for depth, thickness, and quality also underlie a reasonable area within the legal subdivision. The following guidelines will be used.

(1) When classification is based on data available from test holes or surface exposure located within the legal subdivision, this entire legal subdivision will be classified as sodium land if one acre of land is underlain by classifiable sodium deposits.

(2) When a classification action must be based on geologic inference, the entire legal subdivision will be classified as sodium land if 25 percent of the acreage with the legal subdivision can, through geologic inference, be classified as sodium land.

Valuable prospectively determination

The determination of areas valuable prospectively for sodium minerals will be made for areas in which geologic data indicate that such minerals are present and may meet classification standards. Positive information on the quality, thickness, and depth of occurrence may now be lacking, principally because of the absence of adequate mapping and development, but to preserve the Federal mineral estate and prevent the loss of title through nonmineral entities, this type of classification is made.

Sodium brines commonly contain potassium ions; sodium minerals may also contain potassium; and sodium potassium minerals commonly occur in the same deposit. Both sodium and potassium are alkali elements; they have similar chemical properties, form similar compounds and may both be present in one mineral. Since they are both major elements in common rock forming minerals, especially the feldspars, it is not surprising, that with weathering, sodium and potassium are concentrated by rainfall and runoff into lakes and sea water, where under evaporating conditions they have formed brines or precipitated in saline deposits.

In bedded deposits, it is rare to find a sodium brine or deposit completely devoid of potassium ions or minerals. A mineral lease for sodium gives the lessee the right to recover and sell either sodium or potassium, by law. Therefore, the board concludes that it is not correct to approve standards which will retain title to only sodium minerals, and release title to the potassium minerals in the same lands. The board recommends that any sodium deposit which meets the minimum classification standards should automatically be considered valuable prospectively for potassium. This would protect any associated potassium deposits from improvident disposal.

Sodium classification standards

Sodium borates

All the major deposits of sodium borates known in the United States are in California, southwestern Nevada, and southern Oregon (W. C. Smith, 1962). The largest and most productive deposits are at Kramer (W. C. Smith, 1964) and at Searles Lake, Calif. (Smith and Haines, 1964). Other deposits containing sodium borates but formerly worked chiefly for colemanite (calcium borate) are in tilted Cenozoic rocks in the Furnance Creek district at Death Valley (McAllister, 1964), the Calico district near Barstow (Foshag 1921), the Frazier Mountain district in Ventura County (Gale, 1914c), the Lang deposit in Tick Canyon in Los Angeles County, all in California and the Callville Wash (Gale, 1921) and White Basin deposits in Clark County, Nev. Before the turn of the century, sodium borate was produced from Quaternary marsh deposits of borax and ulexite crusts in desert basin playas in these three States.

Thickness.--On a playa surface, a sodium borate deposit as thin as 0.1 foot can be mined. In the early days of borate mining, ulexite and cotton-ball crust deposits on western playas were the major source of borate in the U. S. Bedded sodium borate deposits near the surface can be mined from thin beds by either earth-moving equipment or solution methods. The Sodium Board recommends the establishment of a minimum classifiable thickness of 0.1 foot for surface crusts of sodium borate. The Board also recommends that the minimum classifiable thickness for near-surface bedded deposits should be established at 0.5 foot with a thickness to depth ratio of 1:100 for deposits at depths between 50 and 300 feet. For deposits at depths greater than 300 feet, the minimum classifiable thickness of three feet should remain unchanged. Any continuous interval three or more feet thick must meet or exceed the minimum quality standard (discussed below). Partings and contiguous non-ore beds may be included in this interval.

Depth.--The present depth of workings in the developed deposits is not considered to represent the greatest depths at which either conventional or solution mining could be accomplished. The Board recognizes that solution mining of borates to moderate depths is technically feasible where other conditions are favorable, and concludes that an increase from the 1961 standards is warranted at this time. Therefore, the depth limit for sodium borate deposits should be increased to 10,000 feet.

Quality.--Ulexite has the lowest calculated equivalency of anhydrous sodium tetraborate of those ore minerals of sodium borate currently mined in large quantities from bedded deposits. Pure ulexite has a calculated equivalency of about 24.8 percent anhydrous sodium tetraborate. A 3-foot bed in which ulexite constitutes about 40 percent of the rock is considered minable by underground conventional or solution mining methods. The calculated anhydrous sodium tetraborate equivalency of such a bed is about 10 percent. The Board, therefore recommends that the minimum quality standard for surface and near-surface deposits (to 300 feet depth) should be 5 percent anhydrous sodium tetraborate, and the quality for bedded deposits at depths greater than 300 feet should be reduced from 15 to 10 percent anhydrous sodium tetraborate.

For a brine in which sodium and borate are the dominant ions, concentration is recognized by the Board to be of limited significance because solubility varies significantly as a function of temperature and concentration can be increased by evaporation. The Board recommends that the minimum concentration of a classifiable sodium borate brine should be reduced from 1% (10,000 ppm) to 5,000 parts per million (ppm) $Na_2B_4O_7$ (solid equivalent).

Sodium carbonates

In the United States the largest reserves and production of natural sodium carbonate are from beds of trona in the Green River Formation (Eocene) of southwestern Wyoming (Bradley, 1948, 1959, 1964; Culbertson, 1961). Trona is also a common mineral in lake beds at Searles Lake, Calif. Other sodium carbonate and bicarbonate deposits containing shortite, pirssonite, gaylussite nahcolite, dawsonite, and northupite occur in the Western United States. In the past, sodium carbonate brines in Searles and Owens Lakes, Calif., have been sources of sodium carbonate.

Conclusions by the Sodium Board as to a minimum thickness, depth, and quality of sodium carbonate deposits and brines consider the exceptional occurrences in the Green River Formation and at Searles Lake. These deposits tend to set current economic standards by virtue of their large reserves and proven competitiveness with synthetic sodium carbonate. However, the Board believes that some of the smaller deposits of relatively pure sodium carbonate minerals and brines, as well as some large deposits of double carbonates of sodium with other alkaline earth metals, are potentially competitive locally. Other deposits of mixed saline minerals including sodium carbonate may be subject to solution mining, with production of sodium carbonate as a coproduct.

Thickness.--For several years, trona was scraped from beds less than one foot thick near the surface of Searles Lake, California. The Board concludes that a surface crust 0.1 foot thick is classifiable and because thin bedded sodium carbonate deposits near the surface can be mined by either earth-moving equipment or solution methods, the Board recommends that minimum classifiable limit for near-surface deposits should be reduced to 0.5 foot with a thickness to depth ratio of 1:100 for deposits between 50 and 300 feet be established. For bedded deposits at depths of greater than 300 feet, the minimum thickness should remain three feet. A continuous interval 3 or more feet thick must meet or exceed the minimum quality standards (discussed below). Partings and contiguous non-ore beds may be included in the interval.

Depth.--The present 1,600-foot depth of the deepest mining operations in the trona beds of Wyoming does not represent the greatest depth at which trona can be mined by either conventional or solution mining. The Board considers it reasonable to expect future mining of sodium carbonate deposits as much as 6,000 feet below the surface by conventional mining methods or at even greater depths by solution mining. Therefore, the Board concludes that the maximum depth limit should be increased to 10,000 feet.

Quality.--Trona is the common sodium carbonate mineral presently being mined. Pure trona contains a calculated equivalent of 70.3 percent sodium carbonate. Some deposits of impure trona now mined by conventional underground methods contain only 60 percent sodium carbonate equivalent, and the Board believes that under suitable conditions, beds containing as little as 35.6 percent trona or 25 percent sodium carbonate equivalent could be mined in the future by underground solution methods. It is also necessary however, to consider potentially commercial sodium carbonate minerals lower in sodium carbonate content than trona, such as gaylussite and pirssonite. Pure gaylussite is 35.8 percent sodium carbonate. A bed containing 70 percent gaylussite would contain a calculated equivalent of 25 percent sodium carbonate, as would a bed containing 57 percent pirssonite. Similarly, a bed 39.6 percent nahcolite (sodium bicarbonate) contains a calculated equivalent of 25 percent sodium carbonate. The Board, therefore recommends the minimum quality standard for surface and near-surface sodium carbonate deposits be decreased from 20 to 15 percent sodium carbonate, and the minimum standard for underground deposits be decreased from 40 to 25 percent sodium carbonate.

For natural brines in which sodium and carbonate are the major ions, the concentration is not considered by the Board to be a critical factor because it can be increased by evaporation. The Board recommends therefore, that the minimum classifiable concentration of a natural sodium carbonate brine should be reduced from 3% (30,000 ppm) to 20,000 ppm Na_2CO_3 (solid equivalent).

Sodium chloride

One of the largest sources of sodium chloride is the oceans, which if evaporated to dryness would produce about 4½ million cubic miles of sodium chloride, or 50 percent more than the total volume of the North American continent above sea level (Landes, 1960a). Although much sodium chloride is produced from evaporation of sea water, notably in coastal California (Ver Planck, 1957a) and from Great Salt Lake and other natural brines, more than 90 percent of the United States production is from beds or domes of rock salt mined by conventional or solution mining methods (Lang, 1957; Pierce and Rich, 1962).

The Board, after a review of the occurrences, technology, and marketing trends, has reached the following conclusions as to minimum thickness, depth, and quality, of sodium chloride deposits required for retention classification.

Thickness.--Because sodium chloride is readily soluble in water, any surface crust can be mined. The Board recommends that 0.1 foot should be established as the minimum classification limit for surface crusts. The minimum classifiable thickness for near surface deposits should be established as 0.5 foot with a thickness to depth ratio of 1:100 for deposits at depths of 50 to 300 feet. For deposits at depths greater than 300 feet, the Board recommends that the minimum classifiable thickness be reduced from four to three feet. A continuous interval three or more feet thick must meet or exceed the minimum quality standard (discussed below). Halite beds, partings, and contiguous nonhalite beds may be included in this interval.

Depth.--Because of solution mining techniques, the Board recommends that the maximum depth of a sodium chloride deposit should be increased from 5,000 to ~~10,000~~ 12,000 feet.

Quality.--The Board also recommends that a minimum quality standard should be reduced from 50 percent to 25 percent sodium chloride for surface and near surface deposits and from 85% to 50 percent sodium chloride for bedded deposits at depths of greater than 300 feet.

For a brine to be classified as valuable for sodium chloride, whether surface or underground, the sodium chloride (solid equivalent) content of the brine should be at least as concentrated as normal sea water (about 26,000 ppm). Because a sodium chloride brine can be concentrated by evaporation, greater concentration is not considered a critical factor for land classification purposes, and the Board recommends that the minimum concentration of a sodium chloride brine be reduced from 10% (100,000 ppm) to 26,000 ppm NaCl (Solid equivalent).

Sodium sulfates

Natural deposits of sodium sulfate occur as bedded crystalline deposits and as brines. In the United States today, the largest production of sodium sulfate is from the brines of Searles Lake, Calif. (Ryan, 1951; Bogert, 1963; W. C. Smith, 1964). Sodium sulfate is also produced from brines at Brownfield and Monahans, Tex. (Weisman and Anderson, 1953), and in central Wyoming. In the past, natural sodium sulfate was also produced from many other small deposits in the United States (Bailey, 1902; Arnold and Johnson, 1908; Gale, 1914b; Lang, 1941; Ralston, 1949; Binyon, 1952; Sahinen, 1956, 1963; Wilson and Wideman, 1957; Goudge and Tomkins, 1960; Eardley, 1962).

The following conclusions as to minimum thickness, depth and quality of sodium sulfate deposits have been reached by the Board after a review of the occurrences, of technologic and marketing trends, and of earlier classification standards for sodium lands.

Thickness.--Thin deposits of sodium sulfate have been mined in the past in the Western United States by conventional surface mining methods. Similar deposits are likely to be utilized in the future for new or expanding paper, ceramic or chemical industries. With modern earth-moving equipment surface crusts and thin near surface deposits are considered minable. The Board recommends therefore that the minimum classifiable limit of 0.1 foot for surface crusts and 0.5 foot for near surface deposits be established. A thickness to depth ratio of 1:100 applies to deposits at depths between 50 and 300 feet. Bedded deposits at depth greater than 300 feet continue to have a minimum thickness of three feet. A continuous interval three or more feet thick must meet or exceed the minimum quality standards for sodium sulfate (discussed below). In many cases, ore, partings and contiguous non-ore beds may be included in this interval.

Depth.--The depth limit for mining sodium sulfate by underground or solution mining or natural brine extraction has nowhere been approached because current needs in the United States are largely met from industrial byproducts and the coproducts of natural brines available at shallow depths Sodium sulfate brines or beds at moderate depths could be worked in the future; therefore, the Board concludes that the depth limit of the 1961 standards, 5,000 feet, should be increased to 10,000 feet.

Quality.--Mirabilite is the common sodium sulfate mineral with the lowest amount of equivalent anhydrous sodium sulfate (about 44 percent). A 6-foot bed in which mirabilite constitutes about 45 percent of the rock by weight, including partings, is considered minable by underground conventional or solution mining methods. This bed would be equivalent to a 3-foot bed in which mirabilite constitutes about 90 percent of the bed. The equivalent anhydrous sodium sulfate content of such a 6-foot bed is about 20 percent. The Board concludes that no change from the 1961 standards of the established minimum quality of 10 percent equivalent anhydrous sodium sulfate for surface and near-surface sodium sulfate deposits and 20 percent equivalent anhydrous sodium sulfate for underground bedded deposits is warranted.

Currently, the major United States source of natural sodium sulfate is from the complex Searles Lake Brines. A brine that has a concentration of 70,000 ppm anhydrous sodium sulfate (solid equivalent) is presently being produced at Monahans, Tex. Because a sodium sulfate brine can be enriched by evaporation, concentration is not considered the only significant factor for land classification purposes. The minimum concentration for a sodium sulfate brine should, however, be greater than the highest concentration attained in ground water in such areas as North Dakota and Saskatchewan. The Board recommends that for a brine in which sodium and sulfate ions predominate the minimum classifiable concentration should be changed from 3% (30,000 ppm) to 20,000 ppm Na_2SO_4 (solid equivalent).

Sodium silicates

Sodium zeolites and searlsite (W. C. Smith, 1964) are considered to be leasable sodium silicate minerals; however, at present, no searlsite deposits of commercial importance is known and thus the sodium zeolites set the minimum sodium silicate standards.

Sodium silicates

Sodium zeolite deposits have been identified in several Western States (Bradley, 1928, 1930; Ross, 1928, 1941; Ames and others, 1958; Deffeyes, 1959a, b; Regnier, 1960, Fisher, 1962, 1963; Hay, 1962, 1963, 1964; Hay and Miola, 1963; Sheppard and Gude, 1964; Sheppard and others, 1965, Sand and Regis, 1965). These bedded zeolites occur in diagenetically altered silicic tuff beds. Many of the deposits are in lacustrine and alluvial sedimentary rocks of Cenozoic age, some of which also contain interbedded saline sodium and potassium minerals, lignite, or oil shale--all leasable minerals. Minable altered tuff beds that contain 75 or more percent zeolite have been identified, explored, and locally developed in several places in the Mojave Desert of California (Sheppard and Gude, 1964; Sheppard and others, 1965), in Eureka, Churchill, and Pershing Counties, Nev. (Deffeyes, 1959a, b; Regnier, 1960), in the John Day Formation in Oregon (Fisher, 1962, 1963; Hay, 1963), in the southeastern Oregon (Eberly, 1964) in

Southeastern Arizona (Sand and Regis, 1965), and elsewhere. Although synthetic zeolites still dominate the domestic market, natural zeolite deposits are being mined as new uses for zeolites develop, especially in the petroleum refining industry.

The following conclusions as to thickness, depth and quality of sodium silicate deposits have been reached by the Board after review of the occurrences and technologic and marketing trends of sodium zeolites.

Thickness.--Near surface beds of sodium zeolites several inches thick are currently being strip-mined near Bowie, Arizona (Sand and Regis, 1965). Therefore, the Board recommends the establishment of a minimum classifiable thickness of 0.3 foot for near surface sodium silicate deposits with a thickness to depth ratio of 1:100 to apply to deposits at depths of 30 to 300 feet. The Board also recommends that the minimum thickness of an under-ground sodium silicate deposit at depths of greater than 300 feet be reduced from four to three feet.

Depth.--Because of the present technology and economic conditions and the competition of synthetic zeolites, it is not now believed that natural zeolite deposits will be mined at depths greater than 5,000 feet. Thus the Board recommends that the maximum depth limit for sodium silicate deposits remain at 5,000 feet.

Quality.--The quality of sodium zeolites is judged by the relative abundance of the particular sodium zeolite mineral or minerals in minable beds. At present ore containing about 50% sodium zeolites is being mined near Bowie, Arizona. (Note: Determination of percent zeolite minerals is presently performed by analysis of x-ray data. This method is somewhat inaccurate and judgement must be used in determining whether the quality of the deposit meets the minimum standards.) Accordingly, the Board recommends that the quality for classification of near-surface sodium silicate deposits remain unchanged at 50 percent sodium silicate minerals, but that the minimum quality for sodium silicate deposits at depths greater than 300 feet be reduced from 85 percent to 50 percent sodium silicate minerals in the bed, excluding allowable partings.

Sodium nitrates

The major nitrogen sources in the United States are the atmosphere, coke-oven gas, and organic material-processing plants. Although natural sodium nitrate deposits are widespread throughout the Western United States, these deposits are all small (Noble and others, 1922; Mansfield and Boardman, 1932) and are currently uneconomic. The Board concludes that standards for sodium nitrate need not be set at this time.

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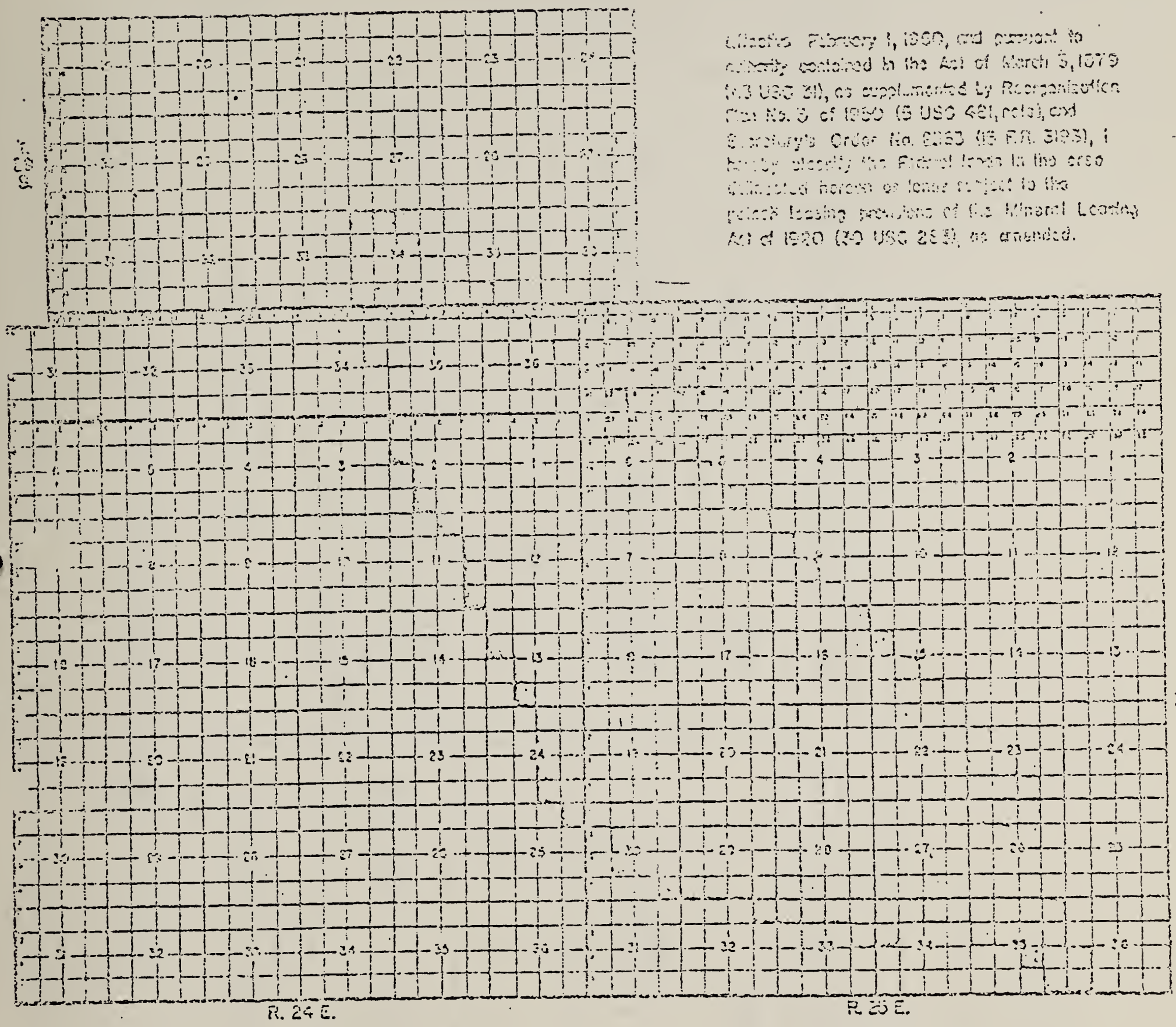
Part 610, Chapter 4.

LISBON VALLEY POTASH AREA

T. 29-29½ S., R. 24 E., T. 29 S., R. 24-25 E., S.L.M., Utah

Example of correct wording on Potash known leasing area

Effective February 1, 1960, and pursuant to authority contained in the Act of March 3, 1879 (43 USC 31), as supplemented by Reorganization Plan No. 3 of 1950 (5 USC 621, note), and Secretary's Order No. 2563 (16 F.R. 3183), I hereby classify the Federal lands in the area delineated hereon as lands subject to the potash leasing provisions of the Mineral Leasing Act of 1920 (30 USC 285), as amended.



Total area subject to lease

16,178 acres

Chief, Conservation Operations Division
U. S. Geological Survey

Nov. 18, 1960

Table 3. Potassium Classification Standards of 1970

Proposed - Thunk (From Crowley 11/2/74)

	Soluble Potassium Minerals		Insoluble Potassium Minerals				Natural Potassium Brines
			Zeolites and Feldspar		Others		
	at depths > 50 feet	at depths < 50 feet	at depths > 50 feet	at depths < 50 feet	at depths > 50 feet	at depths < 50 feet	
Minimum Thickness (feet)	3	0.5	4	0.5	4	0.5	no minimum thickness
Quality	3% K_2O equivalent content		75% potassium mineral in rock		40% potassium mineral in rock		3150 ppm K_2O equivalent or 5000 ppm KCl (4523 ppm K)
Maximum Depth (feet)	14,000		3,000		3,000		14,000
Minimum Quantity Classifiable	1300 tons K_2O equivalent content	300 tons K_2O equivalent content	13,600 tons rock (ore)	1,700 tons rock (ore)	13,600 tons rock (ore)	1,700 tons rock (ore)	300 tons K_2O equivalent content

Brine Conversion Factors:

KCl to K, 0.52;
K_2O to KCl, 1.58;
K_2O to K, 0.83

USGS-BR. of MINERAL CLA...
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NOV 18 1970
MENLO PARK, CALIF.

Criteria for Classification of Sodium Lands

Sodium Chloride

Sodium chloride lands

Lands shall be classified as sodium lands if they contain a deposit of sodium chloride under the following conditions:

1. Thickness - 4 feet or more in crystalline or bedded deposits, exclusive of partings, provided the aggregate thickness of partings does not exceed one-half of the total thickness.

2. Depth - for crystalline deposit: less than 5000 feet; for natural brines and artificial brines by solution mining less than 6500 feet.

3. Quality - (a) in natural solutions, 10 percent or more sodium chloride (total dissolved solids).

   (b) in artificial brines (by solution methods), 25 percent or more NaCl (Total dissolved solids).

   (c) by underground mining methods, 85 percent or more NaCl in crystalline deposits.

   (d) by open cut or strip mining methods, 50 percent or more NaCl for crystalline deposits.

4. Quantity - (a) in crystalline deposits: 12,000 short tons or more in a legal subdivision to be extracted by conventional mining methods.

   (b) in natural brines: (surface or subsurface) sufficient volume of classifiable quality to warrant economic operation based on drill tests or areal investigations.

   (c) in artificial brines: Sufficient volume of classifiable quality to warrant economic operation by solution methods based on drill tests and investigations.

Non-sodium chloride lands

Lands shall be classified as non-sodium if the deposit therein does not qualify under the minimum classification standards set forth in the preceding paragraphs.

Sodium Sulfate

Sodium sulfate lands

Lands shall be classified as sodium lands if they contain a deposit of sodium sulfate under the following conditions:

1. Thickness - 3 feet, or more in crystalline or bedded deposits, exclusive of partings, provided the aggregate thickness of partings does not exceed one-half of that thickness.

2. Depth - 5000 feet or less

3. Quality - (a) in natural solutions 3 percent or more Na_2SO_4.

   (b) in artificial solutions (by solution methods) 15 percent or more Na_2SO_4 (total dissolved solids).

   (c) by underground mining methods 20 percent or more Na_2SO_4 in crystalline deposits.

   (d) by open-cut or strip mining methods, 10 percent or more Na_2SO_4 for crystalline deposits.

4. Quantity - (a) in crystalline deposits: 11,000 short tons or more in a legal subdivision extracted by conventional mining methods.

   (b) in natural brines: Surface or subsurface, sufficient volume of classifiable quality to warrant economic operation based on drill tests or areal investigation.

   (c) in artificial brines: Sufficient volume of classifiable quality to warrant economic operation by solution methods based on drill tests and investigations.

Non-sodium sulfate lands

Lands shall be classified non-sodium if the deposit therein does not qualify under the minimum classification standards set forth in the preceding paragraphs.

Sodium Carbonate

Sodium carbonate lands

Lands shall be classified as sodium lands if they contain a deposit of sodium carbonate under the following conditions:

1. Thickness - 3 feet or more in crystalline or bedded deposits exclusive of partings, provided the aggregate thickness of partings does not exceed one-half of total thickness.

2. Depth - less than 5,000 feet

3. Quality - (a) in natural brines, 3 percent or more Na_2CO_3 (total dissolved solids).

   (b) in artificial brines, (by solution methods) 15 percent or more Na_2CO_3 (total dissolved solids).

   (c) by underground mining methods, 40 percent or more Na_2CO_3, in crystalline deposits.

   (d) by open-cut or strip mining methods, 20 percent or more Na_2CO_3 for crystalline deposits.

4. Quantity - (a) in crystalline deposits: 8700 short tons in a legal subdivision extracted by conventional mining methods.

   (b) in natural brines: Surface or subsurface, sufficient volume of classifiable quality to warrant economic operation based on drill tests or areal investigation.

   (c) in artificial brines: Sufficient volume of classifiable quality to warrant economic operation by solution methods based on drill tests and investigations.

N sodium carbonate lands

Lands shall be classified as non-sodium lands if the deposit therein does not qualify under the minimum classification standards set forth in the preceding paragraphs.

Sodium Borates

Sodium borate lands

Lands shall be classified as sodium lands if they contain a deposit of sodium borate under the following conditions:

1. Thickness - 3 feet or more in crystalline or bedded deposits exclusive of partings, provided the aggregate thickness of partings does not exceed one-half of total thickness.

2. Depth - 5000 feet or less

3. Quality - (a) in natural solutions, 1.0 percent or more B_2O_3 as sodium borate.

   (b) in artificial solutions, (by solution methods) 10 percent or more B_2O_3 as sodium borate.

   (c) by underground mining methods, 15 percent or more B_2O_3 as sodium borate in crystalline deposits.

   (d) by open-cut or strip mining methods, 5 percent or more B_2O_3 as sodium borate in crystalline deposits.

4. Quantity - (a) in crystalline deposits: 7800 short tons or more in a legal subdivision extracted by conventional mining methods.

   (b) in natural brines: Surface or subsurface sufficient volume of classifiable quality to warrant economic operation based on drill tests or areal investigations.

   (c) in artificial brines: Sufficient volume of classifiable quality to warrant economic operation by solution methods based on drill tests and investigations.

N-sodium borate lands

Lands shall be classified as non-sodium lands if the deposit therein do not qualify under the minimum classification standards set forth in the preceding paragraphs.

Sodium Silicate

Sodium silicate lands

Lands shall be classified as sodium lands if they contain a deposit of hydrous sodium silicate having the physical and chemical properties common to sodium zeolite under the following conditions:

1. Thickness - 4 feet or more in crystalline or bedded deposits exclusive of partings, provided the aggregate thickness of partings does not exceed one-half of total thickness.

2. Depth - 5000 feet or less

3. Quality - for recovery by underground mining methods: 85 percent or more hydrous sodium aluminum silicate (zeolite); for recovery by open cut or stripping methods; 50 percent or more hydrous sodium silicate (zeolite).

4. Quantity - in crystalline or bedded deposits: 12,000 short tons or more in a legal subdivision to be extracted by conventional mining methods.

Non-sodium silicate lands

Lands shall be classified as non-sodium lands if the deposit therein does not qualify under the minimum classification standards set forth in the preceding paragraph.

United States Department of the Interior

GEOLOGICAL SURVEY
9277 West Alameda Avenue
Lakewood, Colorado 80226

November 12, 1976

Memorandum

To: Chief, Branch of Onshore Evaluation

From: Chief, Branch of Mineral and Water Classification

Subject: Classification Standards for Sodium Lands

The first classification standards for sodium lands were approved by the Director, July 24, 1961. On March 2, 1961, the Chief, Branch of Mineral Classification directed the Regional Geologists at Denver, Colorado, Los Angeles, California, Great Falls, Montana, Roswell, New Mexico, and Tulsa, Oklahoma, to prepare maps on the scale of 1:500,000 showing lands valuable prospectively for sodium, and for asphalt and bituminous rock.

Known deposits of sodium minerals and of saline lakes and playas of the West were mentioned on pages 134 to 137 in Geological Survey Bulletin 537, The Classification of the Public Lands by George Otis Smith and Others, 1913, but no guidelines on classifying sodium lands were established. By the Mineral Leasing Act of 1920, sodium minerals became leasable commodities.

Prior to July 24, 1961, classification of Federal Lands with respect to sodium was done primarily in preparing mineral reports to BLM and other Government agencies in connection with disposal cases. Classification was done on a case by case basis considering only the lands of the particular case. Guidelines for making these classifications were never formally stated, but were understood by geologists making the classification determinations and were transmitted from one geologist to another in the course of the work. These guidelines were based on the experiences of industry in developing the commodity being classified. Basic considerations were the intrinsic factors of quality, thickness, and depth. Although the extrinsic factors of distance from a market and transportation affect the market value of a commodity, they are not considered because classification includes not only lands with deposits that are recoverable under today's economic conditions, but also lands with deposits that may become recoverable at some time in the future.

Andrew F. Bateman, Jr.
Chief, Branch of Mineral and Water Classification

cc: ADC/RE

Valuable sodium deposit. 30 U.S.C. 261 and 262 authorizes the lease of valuable deposits of one of the sodium substances enumerated as chlorides, sulfates, carbonates, borates, silicates, or nitrates of sodium. The important point here is that it must be a deposit and that it must be valuable in terms of gross value of the output of sodium compounds and other related products at the point of shipment to market. The key word, "deposit," is predominant over the key words "sodium chloride" since the deposit is expected to contain not only sodium compounds but other related products. The value is in the deposit, not just in the sodium compounds that characterize the deposit.

Chiefly valuable. This requirement applies only to applications for preference right leases. In order to obtain a preference right lease from a prospecting permit, the applicant must demonstrate not only that the land contains valuable deposits of sodium; but also that the land is chiefly valuable for sodium. This requirement applies to the deposit, not just to the sodium in the deposit. Thus, the value of a sodium deposit with other related products is the sum of the value of the output from the deposit. To determine chiefly valuable, this value is compared to the value of other mineral deposits in the land, such as coal, oil, or gas lying at different depths in the crust of the earth, and to surface values such as grazing, timber, and recreation.

Cadiz Lake. At Cadiz Lake, the deposit is clearly a sodium deposit, because sodium is the predominant cation. Accordingly, the entire

deposit--a brine--is leasable rather than locatable. The calcium chloride is "a related product" in the brine. The sodium brine, including the calcium chloride, is clearly more valuable than oil and gas, coal, phosphate, gold, grazing, timber, recreation, or any other element of value in the particular lands. Accordingly, the land is not only valuable for sodium but also chiefly valuable for the sodium deposit.

Prudent man. This longstanding principle, enumerated above, has governed the actions of the Department for many years. The prudent-man concept, as revised and restated by the Department, does not change the relative resource values at Cadiz Lake.

Clayton Lake. Any failure to sustain this principle in this particular case will jeopardize previous decisions, notably the Foote Mineral operation at Clayton Lake in Nevada. There the operator holds potash and sodium leases and is recovering only part of the brine deposit, namely, the lithium chloride, returning the sodium and potassium chloride portions of the brine to the lake for future recovery.

Operator choices. That a given operator chooses to produce a brine constituent other than sodium or potassium at any given time in history from a leasable deposit would not mean that another lessee might not elect to recover the sodium or potassium. In fact, what he recovers is irrelevant, since it is the brine deposit that is leasable. At both Cadiz Lake and Clayton Lake, the sodium or potassium constituents of the brines predominate.

TABLE 1

SOME LEASABLE SODIUM MINERALS

Halides (chlorides)	
Halite (common salt)	$NaCl$
Carbonates	
Nahcolite	$NaHCO_3$
Dawsonite	$NaHCO_3 \cdot AlO(OH)$
Trona	$Na_2CO_3 \cdot NaHCO_3 \cdot 2H_2O$
Wegscheiderite	$Na_2CO_3 \cdot 3NaHCO_3$
Thermonatrite	$Na_2CO_3 \cdot H_2O$
Natron	$Na_2CO_3 \cdot 10H_2O$
Pirssonite	$Na_2CO_3 \cdot CaCO_3 \cdot 2H_2O$
Gaylussite	$Na_2CO_3 \cdot CaCO_3 \cdot 5H_2O$
Shortite	$Na_2CO_3 \cdot 2CaCO_3$
Northupite	$Na_2CO_3 \cdot MgCO_3 \cdot NaCl$
Tychite	$2Na_2CO_3 \cdot 2MgCO_3 \cdot Na_2SO_4$
Bradleyite	$Na_3PO_4 \cdot MgCO_3$
Borates	
Kernite	$Na_2B_4O_7 \cdot 4H_2O$
Tincalconite	$Na_2B_4O_7 \cdot 5H_2O$
Borax	$Na_2B_4O_7 \cdot 10H_2O$
Probertite	$NaCaB_5O_9 \cdot 5H_2O$
Ulexite	$NaCaB_5O_9 \cdot 8H_2O$
Teepleite	$Na_2B_2O_4 \cdot 2NaCl \cdot 4H_2O$
Nitrates	
Soda - Niter	$NaNO_3$
Darapskite	$NaNO_3 \cdot Na_2SO_4 \cdot H_2O$
Sulfates	
Thenardite	Na_2SO_4
Mirabilite	$Na_2SO_4 \cdot 10H_2O$
Schairerite	$Na_2SO_4 \cdot Na(F, Cl)$
Sulfohalite	$2Na_2SO_4 \cdot NaF \cdot NaCl$
Burkeite	$2Na_2SO_4 \cdot Na_2CO_3$
Vanthoffite	$3Na_2SO_4 \cdot MgSO_4$
Loeweite	$2Na_2SO_4 \cdot 2MgSO_4 \cdot 5H_2O$
Bloedite	$Na_2SO_4 \cdot MgSO_4 \cdot 4H_2O$
Glauberite	$Na_2SO_4 \cdot CaSO_4$
Hanksite	$9Na_2SO_4 \cdot 2Na_2CO_3 \cdot KCl$
Aphthitalite (glaserite)	$(Na, K)_2SO_4 \cdot K_2SO_4$
Silicates	
* Analcime	
Chabazite	
Clinoptilolite	
Erionite	
Faujasite	

TABLE 1

SOME LEASABLE SODIUM MINERALS

Cont.	
Mordenite*	
Phillipsite*	
Searlasite	$NaBSi_2O_6 \cdot H_2O$

* A partial list of zeolites - hydrous aluminum silicates with exchangeable sodium, potassium, and other cations. See figure 1.

9277 West Alameda Avenue
Lakewood, Colorado 80226

November 15, 1976

RECEIVED
MAR 2
Conservation Division
U.S. GEOLOGICAL SURVEY

Memorandum

To: Chief, Branch of Onshore Evaluation

From: Chief, Branch of Mineral and Water Classification

Subject: Classification Standards for Sodium Lands

Known deposits of sodium minerals and of saline lakes and playas of the West were mentioned on pages 134 to 137 in Geological Survey Bulletin 537, The Classification of the Public Lands by George Otis Smith and Others, 1913, but no guidelines on classifying sodium lands were established. By the Mineral Leasing Act of 1920, sodium minerals became leasable commodities.

In the following years, the classification of Federal Lands with respect to sodium was done primarily in preparing mineral reports to BLM and other Government agencies in connection with disposal cases. Classification was done on a case by case basis considering only the lands of the particular case. Guidelines for making these classifications, based on the experiences of industry in developing sodium deposits, were gradually evolved. These guidelines were understood by the geologists making the classification determinations and were transmitted from one geologist to another in the course of work. Basic considerations were the intrinsic factors of quality, thickness, and depth. Although the extrinsic factors of distance from a market and transportation effect the market value of a commodity, they were not considered because classification includes not only lands with deposits that are recoverable under today's economic conditions, but also lands with deposits that may become recoverable at some time in the future.

Finally these guidelines were formally outlined as classification standards in Minutes of the Sodium Board approved by the Director, July 24, 1961. On March 2, 1961, the Chief, Branch of Mineral Classification had directed the Regional Geologists at Denver, Colorado, Los Angeles, California, Great Falls, Montana, Roswell, New Mexico, and Tulsa, Oklahoma, to prepare maps on the scale of 1:500,000 showing lands valuable prospectively for sodium, and for asphalt and bituminous rock.

From the above discussion, it appears that the unwritten standards for the classification of sodium lands used informally in 1951 were essentially the same as those expressed in the first formal classification standards for sodium lands approved by the Director on July 24, 1961.

/s/ Andrew F. Bateman, Jr.

Andrew F. Bateman, Jr.
Chief, Branch of Mineral and Water
Classification

cc: ADC/RE

United States Department of the Interior

GEOLOGICAL SURVEY
RESTON, VIRGINIA 22092

In Reply Refer To:
EGS-Mail Stop 640

Conservation Division
U.S. GEOLOGICAL SURVEY
Office of the Area Geologist
Menlo Park, California
AUG 1 1977

JUL 26 1977

Memorandum

To: Solicitor

Through: Assistant Secretary--Energy and Minerals

From: Director, Geological Survey

Subject: Composition of bentonite (SEE DECISION ON ZEOLITES BELOW)

The Deputy Solicitor's memorandum of March 11, 1977, requested that we reexamine our memorandum of November 11, 1971, on the composition of bentonite. We have now completed an updated review of the mineral composition of bentonite from the standpoint of whether such minerals are leasable or locatable (see enclosed memorandum of June 14, 1977). We have also noted the IBLA decision (75-29, United States v. Union Carbide) on zeolites of June 24, 1977. Inasmuch as bentonites and zeolites are similar, in that both have ion exchange characteristics, this decision would also relate to the classification of bentonites. Bentonites and zeolites may be classified in several ways depending upon the guidelines chosen.

Based on our updated review of June 14, 1977, we find no reason to modify our November 11, 1971, memorandum on the classification of bentonite except on the following two points: (1) most sodium in bentonite occurs as an exchangeable cation in montmorillonite, the principal clay mineral in bentonite, rather than both as an exchangeable cation and in a structural position, and (2) the dominant cation may vary vertically as well as horizontally within a single bed. This updated review further emphasizes the complexity of classification of bentonite deposits.

Some of the bentonites being produced in Wyoming and elsewhere contain as much as 2.5 percent sodium and hence may be described as sodium-bearing. But because sodium is not an essential component of montmorillonite, it cannot be classed mineralogically as a silicate of sodium. This is one of the tests established in IBLA decision 75-29 on zeolites, the other being that sodium be present in sufficient quantity to be commercially valuable. No bentonites can be classed as a commercial source of sodium, although the presence of sodium may be one of the factors that contribute to the physical properties that make it valuable.

In light of the above, we propose to consider all zeolite and bentonite deposits as locatable until such time as further guidelines are provided or changes are made in the applicable legislation.

V.E. McKelvey

Director

Enclosures

cc: Secretary Surname
Secretary Reading File (2)
AS/EM (2)
Gen. Files=-MS114/Reston
Dir. Chron.--MS114/Reston
CD:640-0:
ADC/RE
RE Chrons
C/BOE
C/BMWC
C/CD--MS600
Chief Geologist--MS911
S.Patterson--MS954/Reston
R.Sheppard--GD/Denver
C.Wolfbauer--GD/Denver
CM/ER
CM/CR
CM/WR
Area Geologists
Eastern Area Supervisor-Res. Evaluation

CD:RLRioux:SPatterson:CWolfbauer:ms:7/14/77:860-7571
Retyped (second page):ms:7/19/77
Rewritten:VMcKelvey:ms:7/22/77:860-7571

USGS-BR. of MINERAL
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NOV 18 197
MENLO PARK CALIF.

Criteria for Classification of Potash (Potassium) Lands

Lands shall be classified as potash land if they contain potassium minerals that may be extracted from sedimentary deposits by dry mining or if they contain a lake, playa, or deposit of potassium minerals recoverable from solutions obtained, for example, by pumping, by wells, or by solution mining under the following conditions.

Bedded deposits by dry mining

(a) Minimum thickness - 4 feet

(b) Minimum quality - 8% K_2O equivalent as sulphate ore
- 14% K_2O equivalent as chloride ore

(c) Maximum depth - 5000 feet for ore of minimum quality and thickness.

Brines and solution mining

(a) Thickness of porous crystal body, bed, or mass - 5 feet or more exclusive of partings, provided the aggregate thickness of partings does not exceed one-half of the total thickness.

(b) Depth -6500 feet or less.

(c) Quality - in natural or in artifical solutions at least 1 percent KCl (total dissolved solids) or its equivalent as K_2O.

(d) Quantity - in natural or artificial brines (surface or subsurface), sufficient volume of substained yield of classifiable quality to warrant economic operation based on drill tests and other investigations.

Classification by Legal Subdivisions -- Classification shall be made by quarter-quarter sections, surveyed tracts, or lots.

UNITED STATES

DEPARTMENT OF THE INTERIOR

Geological Survey

Reston, Virginia

Potassium Land Classification Order California No. 2

Pursuant to authority under the Act of March 3, 1879 (20 Stat. 394; 43 U.S.C. 31) and as delegated to me by Departmental Order 2563 of May 2, 1950, under authority of Reorganization Plan No. 3 of 1950 (64 Stat. 1262), the following described lands, insofar as title thereto remains in the United States, are hereby classified as shown:

Mount Diablo Meridian, California

Nonpotash Lands

T. 26 S., R. 43 E., Sec. 16

The area described aggregates 640 acres, more or less, all of which are classified nonpotash lands.

_____

Director

_____

Date

RECEIVED
Geological Survey
APR 7 1977
Conservation Division
Western Region
Menlo Park, Calif.

United States Department of the Interior

GEOLOGICAL SURVEY
9277 West Alameda Avenue
Lakewood, Colorado 80226

April 5, 1977

Memorandum

To: Area Geologist, Menlo Park

Through: Conservation Manager, Western Region

From: Chief, Branch of Mineral and Water Classification

Subject: Classification of sec. 16, T. 26 S., R. 43 E., Mount Diablo Meridian, San Bernardino County, California

The attached California Potassium Land Classification Minutes No. 2 have been retyped and are returned herewith for signature.

A. F. Bateman, Jr.

A. F. Bateman, Jr.
Chief, Branch of Mineral and Water Classification

Enclosure

EVOLUTION BICENTENNIAL
1776-1976

Minutes of the Mineral Land Classification Committee

Date: March 15, 1977

Subject: Potassium classification of section 16, T. 26 S., R. 43 E., Mount Diablo Meridian, San Bernardino County, California

Minutes prepared by: J. P. Calzia

Classification committee present: J. P. Calzia, J. A. Crowley, and H. L. Cullins

In Consultation: E. Vernon Stephens and G. I. Smith

Introduction

Section 16, T. 26 S., R. 43 E., is in Potash Reserve No. 2, California No. 1, established by Order of Withdrawal on February 21, 1913.

The basis for board action in classifying the land is supported by the work of Haines (1959), Smith (1973) and other geologic data in the files of the Area Geologist.

Geographic Setting

Searles Lake is 130 miles northeast of Los Angeles, California, and approximately 25 miles west of Death Valley, California, in the southwestern corner of the Basin and Range geologic province.

Geology

The stratigraphy, extent, and composition of the saline deposits at Searles Lake has been described by Haines (1959) and Smith (1973). The stratigraphic units and their relationships are shown on Figure 1. Brine analysis from 33 test wells (Figure 2) indicate: (a) the brines decrease in percent KCl from east to west; and (b) the salt layers, described on Figure 1, pinch out east of section 16.

The Geological Survey considers the minimum potassium concentration of natural brines for classification as potassium land to be 1.0 percent KCl. The brine from the upper salt layer encountered in well SL-8, located a half mile east of section 16, contains 1.2 percent KCl. A brine analysis from well 744-9000-6, located in the southeast corner of section 16, contains approximately 0.2 percent KCl. Another analysis, from well SG-1019, located in the northwest quarter of section 17, contains approximately 0.08 percent KCl. These brine analyses, plus the test well data described above, indicate the concentration of potassium in brines underlying section 16 is less than that required for classification as potassium land.

Description of Land

Based on the above geologic and test well data, the following described lands, including 640 acres more or less, are classified nonpotassium.

Mount Diablo Meridian, California

T. 26 S., R. 43 E.
sec. 16: all.

Restoration of the lands classified herein is recommended.

References

Haines, D. V., 1959, Core Logs from Searles Lake, San Bernardino County, California: U.S. Geol. Survey Bull. 1045-E, p. 139-317.

Smith, G. I., 1973, Subsurface stratigraphy and composition of saline bodies, Searles Lake, California: A preliminary report: U.S. Geol. Survey Open-File Report, 118 p.

Submitted and recommended by the Committee:

Geologist — Member

Geologist — Member

Area Geologist — Chairman

Reviewed by: _____ Date: _____
Acting Conservation Manager
Western Region

Approved by: _____ Date: _____
Acting Chief, Conservation
Division

Enclosures: Plat
Figures 1, 2, and 3

cc: Area Geologist, Menlo Park, CA
Regional Cons. Mgr., Menlo Park, CA
Chief, BMNC, Denver, CO

Conservation Division
Area Geologist's Office
345 Middlefield Road
Menlo Park, California 94025

March 15, 1977

Memorandum

To: Chief, Conservation Division

Through: Conservation Manager, Western Region
Chief, Branch of Mineral and Waterpower Classification, Denver

From: Office of Area Geologist, Menlo Park

Subject: Classification of section 16, T. 26 S., R. 43 E., Mount Diablo Meridian, located in Potash Reserve No. 2, California No. 1, Searles Lake, California

Attached for review, signature, and transmittal are:

(1) Classification minutes of the subject area
(2) Memo to Director, BLM, from Director, USGS
(3) Notice to the Federal Register

The format of the memorandum between the two Directors describing the classification of part of Potash Reserve No. 2 (established by Order of Withdrawal February 21, 1913) was prescribed by the Chief, Conservation Division in his memorandum dated November 11, 1973.

Henry L. Cullins
Pacific Area Geologist

cc: Director, USGS
Chief, Conservation Division
ADC, Resource Evaluation
Chief, Br. of Mineral and Waterpower Classification
Conservation Manager, Western Region
Area Geologist, Pacific Area

California Potash Land Classification Minutes No. 2

Minutes of the Mineral Land Evaluation Committee

Date: March 15, 1977

Subject: Classification of section 16, T. 26 S., R. 43 E., Mount Diablo Meridian, located in Potash Reserve No. 2, California No. 1, Searles Lake, California

Evaluation Committee Present: J. P. Calzia, J. A. Crowley, H. L. Cullins

In Consultation: E. Vernon Stephens and G. I. Smith

Introduction

The Bureau of Land Management has requested an examination and mineral land classification of section 16, T. 26 S., R. 43 E., in Potash Reserve No. 2, California No. 1, Searles Lake, California, in order to process land adjudication matters. The potash reserve was established by Order of Withdrawal on February 21, 1913.

Legal Consideration

The proposed classification of a part of Potash Reserve No. 2, California No. 1 has been evaluated on the basis of all available geologic data, as specified in the Mineral Leasing Act of 1920 and as amended.

Geographic Setting

Searles Lake is located 130 miles northeast of Los Angeles, California and approximately 25 miles west of Death Valley, California in the southwestern corner of the Basin and Range geologic province.

Geology

The stratigraphy, extent, and composition of the saline deposits at Searles Lake has been described by Haines (1959) and Smith (1973). The stratigraphic units and their relationships are shown on Figure 1. Brine analysis from 33 test wells (Figure 2) indicate: (a) the brines decrease in percent KCl from east to west; and (b) the salt layers, described on Figure 1, pinch out east of section 16.

The Geological Survey considers the minimum potash concentration of natural brines for classification as potash land to be 1.0 percent KCl. The brine from the upper salt layer encountered in well SL-8, located a half mile east of section 16, contains 1.2 percent KCl. A brine analysis from well 744-9000-6 located in the southeast corner of section 16, contains approximately 0.2 percent KCl. Another analysis, from well SG-1019 located in the northwest quarter of section 17, contains approximately 0.08 percent KCl. These brine analyses, plus the test well data described above, indicate the concentration of potash in brines underlying section 16 is less than that required for classification as potash land.

Description of Land

Based on the above geologic and test well data, the following described lands, including 640 acres more or less, are classified nonpotash.

Mount Diablo Meridian, California

T. 26 S., R. 43 E.

sec. 16: all

It is recommended that the above described nonpotash lands be restored to the public domain.

References

Haines, D. V., 1959, Core Logs from Searles Lake, San Bernardino County, California: U. S. Geol. Survey Bull. 1045-E, p. 139-317.

Smith, G. I., 1973, Subsurface stratigraphy and composition of saline bodies, Searles Lake, California: A preliminary report: U. S. Geol. Survey Open-File Report, 118 p.

Submitted and recommended by the Committee

J. P. Calzia — Member

J. A. Crowley — Member

H. L. Cullins — Chairman

Minutes Prepared by: J. P. Calzia

Reviewed by: _____ Date: March 15, 1977

Acting Conservation Manager
Western Region

Approved by Mineral Land Classification Board

_____ Member

_____ Member

_____ Chairman

Date: _____

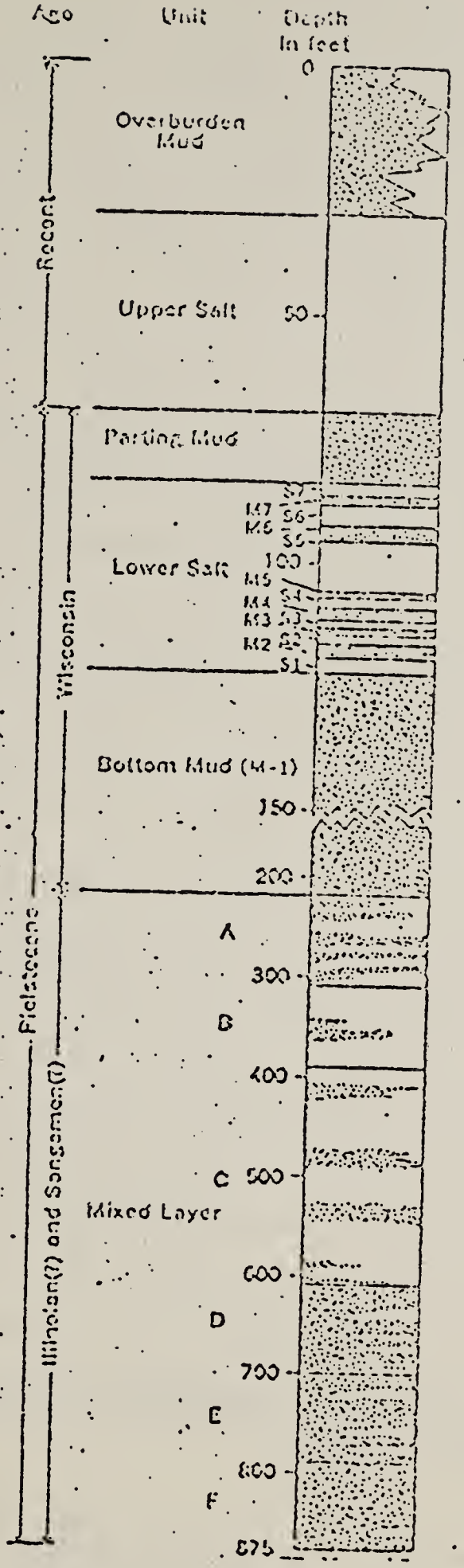


Figure 1. Summary of stratigraphic units in Searles Lake evaporite sequence (from Smith, 1973).

STATE CALIFORNIA T.26S. R.43E. MDM. MSD.

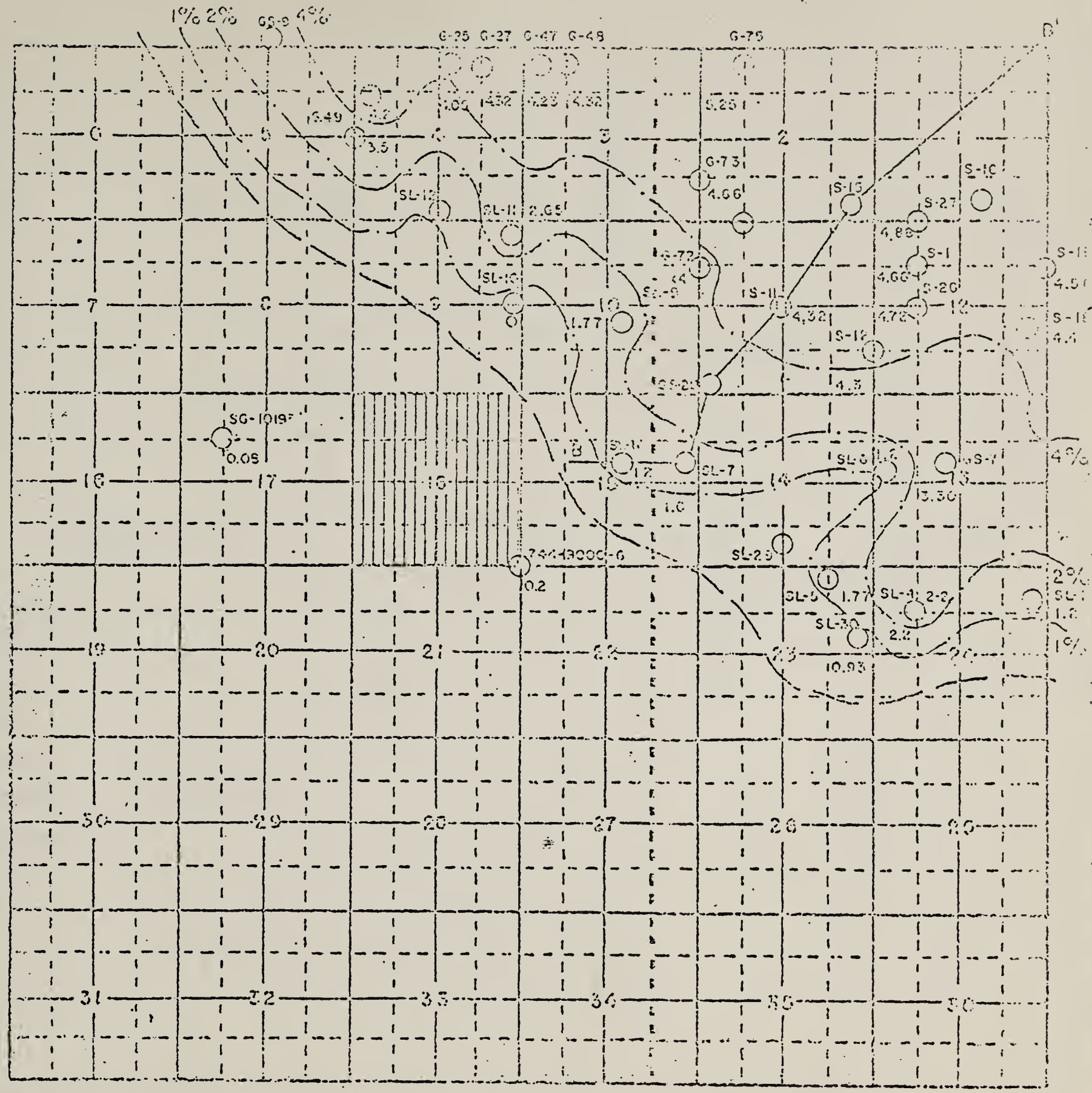


Figure 2. Saline deposits in T. 26 S., R. 43 E., MDM, California

Scale 1:62,500

POTASH RESERVE NO. 2, CALIFORNIA NO. 1 (ESTABLISHED BY ORDER OF WITHDRAWAL 2/21/13; ENCOMPASSES ENTIRE TOWNSHIP)

LANDS CLASSIFIED AS NON-POTASH AND RECOMMENDED FOR RESTORATION FROM POTASH RESERVE NO. 2, CALIFORNIA NO. 1 (THIS MEMORANDUM)

LOCATION OF CORE HOLE WITH PERCENT KCL OF RICHEST BRINE ANALYSIS AVAILABLE

S-26
4.75

APPROXIMATE ZERO ISOPACH OF UPPER OR LOWER SALT, WHICHEVER IS OUTERMOST

ISOPLETH OF KCL BRINE, CONTOURED AT 1%, 2% AND 4% KCL

B'
B

SECTION ALONG LINE B-B' (See Fig. 3)

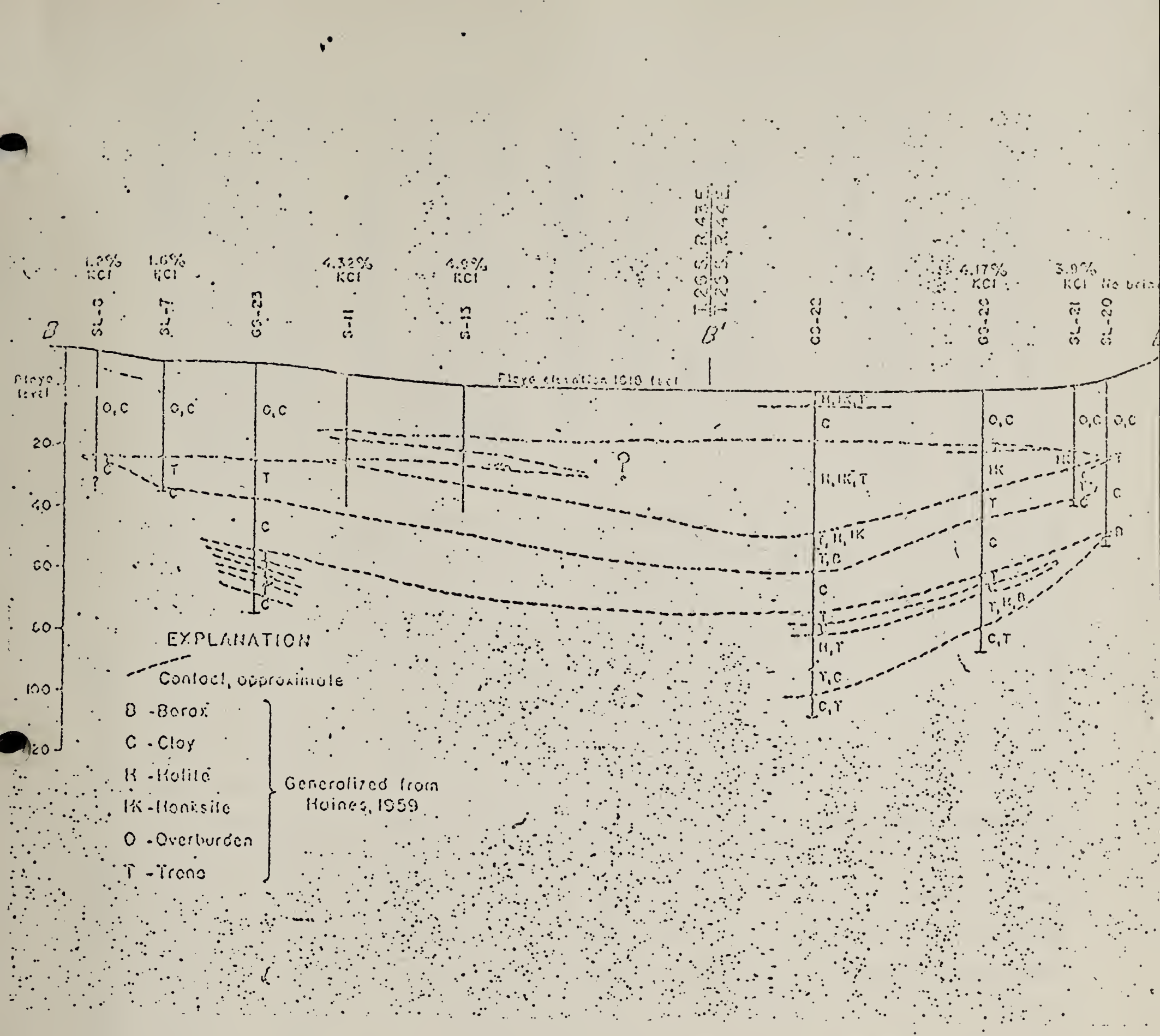
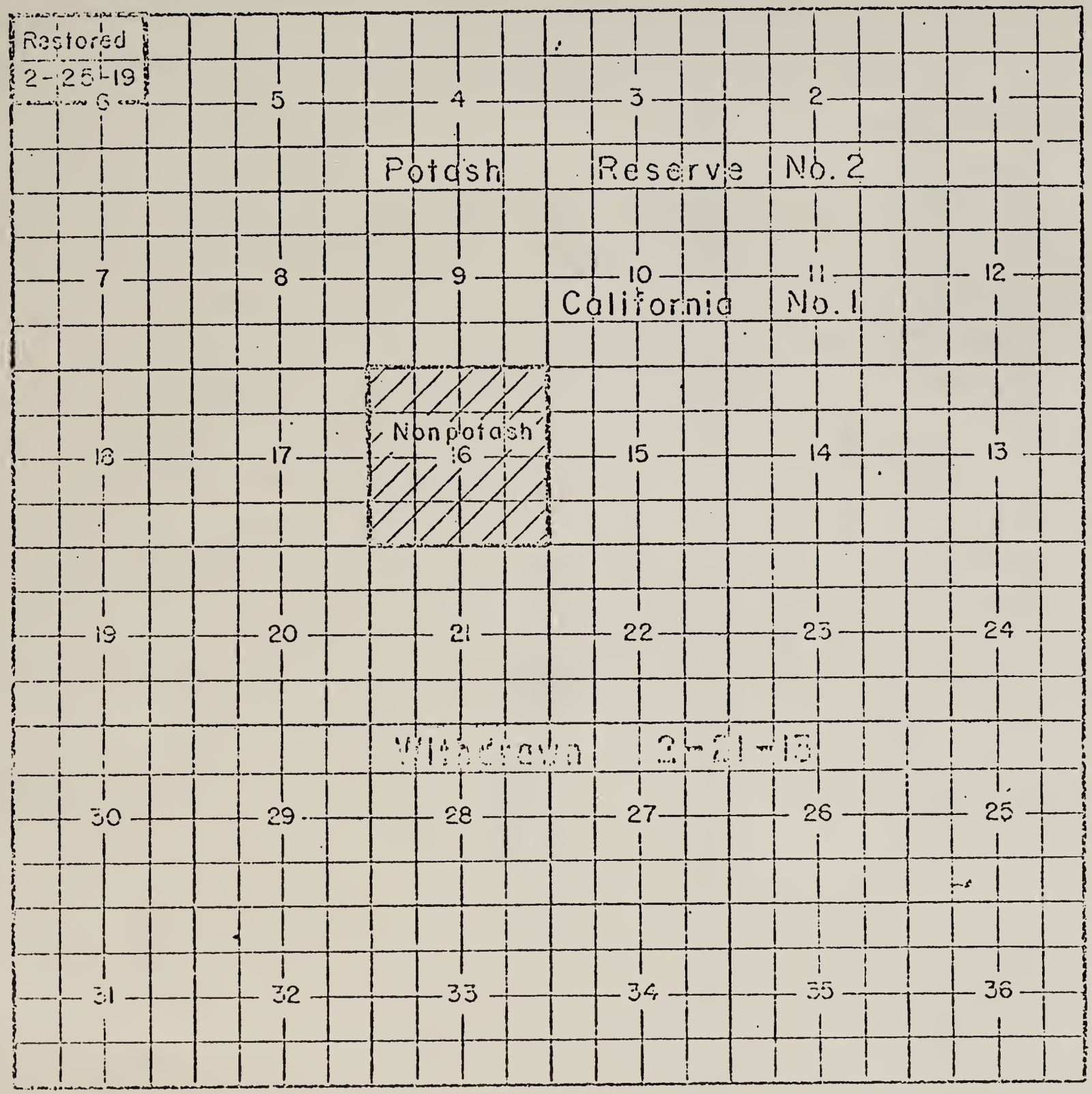


Figure 3. Section along line B-B'-B", T. 26 S., R. 43 E., and T. 25 S., R. 44 E., MDM, California. Horizontal scale 1:63,360; vertical scale 1:634.

T.26S., R.43E., MDM, California



CLASSIFIED	Mineral	Nonmineral
Classified by this action	—	640
Reclassified by this action	—	—
Prior classification	—	—
Total acres classified to date	—	640

NOT CLASSIFIED	
Not withdrawn	240
In outstanding withdrawal	22,5824
Restored without classification	—
Total acres not classified	22,8224

Total acres in township 23,462.4

Classified on dates shown as:

Mineral

Nonmineral

Not classified

New classification approved by the Director, U. S. Geological Survey, ..., published in Federal Register v. ....., p. ....., ...

Restored from ....., ..., by Public Land Order ....., published in Federal Register v. ....., p. ....., ...

United States Department of the Interior

GEOLOGICAL SURVEY
RESTON, VIRGINIA 22092

March 15, 1977

Memorandum

To: Director, Bureau of Land Management

From: Director, Geological Survey

Subject: Classification of part of Potash Reserve No. 2
California No. 1, Searles Lake, California

The land in this proposal is part of Potash Reserve No. 2, California No. 1, established by Order of Withdrawal on February 21, 1913. Geologic data and the results of drilling to date indicate a part of the Reserve does not contain sufficient concentration of potassium in brines to be classified. This land, encompassing 640 acres, more or less, is described as follows:

Mount Diablo Meridian, California

T. 26 S., R. 43 E., sec. 16

In view of the conditions cited, it is recommended that the lands described above be classified nonpotash and restored to the public domain.

Director
U. S. Geological Survey

AMERICA'S REVOLUTION BICENTENNIAL 1776-1976

BLM Library
Denver Federal Center
Bldg. 50, OC-521
P.O. Box 25047
Denver, CO 80225